RADAR Western Cape 2010

Risk and Development Annual Review

Disaster Mitigation for Sustainable Livelihoods Programme

RADAR Western Cape

2010

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Acknowledgments

This first Risk and Development Annual Review for the Western Cape represented a mammoth undertaking that reflected eight years of post-disaster research across the province. The Disaster Mitigation for Sustainable Livelihoods Programme would like to acknowledge the contribution made by the many individuals and groups whose support and input made this first *RADAR* possible.

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The process of consolidating the information from these reports with data from more recent events up until 2008 constituted a major challenge. This was only possible due to the skill and commitment of the *RADAR* research team, especially Andy Duncan, Patience Mandeya, Chiedza Mavengere, Michael O'Donovan, Rifqah Roomaney, Natalie Schell and FJ Solomon.

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RADAR was only possible due to the guidance and encouragement provided by a dedicated publication advisory committee. In this, we gratefully acknowledge Dennis Laidler and Mmaphaka Tau and especially, Elmien Steyn for her enthusiasm and understanding.

Last, we wish to express our appreciation for the generous financial support by the Department of Cooperative Governance and Traditional Affairs through the National Disaster Management Centre. We are also grateful for research funding provided by the Cape Higher Education Consortium and co-funding offered by the Office of Foreign Disaster Assistance of the United States Agency for International Development as part of its support to the Periperi U project.

FOREWORD

by the South African National Minister for Cooperative Governance and Traditional Affairs

Historically households, communities and societies have continuously sought to protect their property and livelihood from extreme events and disasters. They investigated and found ways and methods to improve the sighting, positioning and building of their structures and ways to safeguard their economic activities against these destructive events. These search efforts tended to focus on threatening hazards and their impact on the communities and their livelihoods. However, as populations increase - with the consequence that the built environment increases in size - coupled with the effects of climate variability, there emerges greater pressure on the need for determining and addressing vulnerabilities and exposure to these extreme and disastrous events faced by societies.

Considering this international paradigm for disaster management and South Africa's policy and legislative requirements for the determination of hazards and vulnerabilities towards those hazards conditions, the Risk and Development Annual Review (*RADAR*) project was commissioned to investigate severe weather induced disasters experienced in the Western Cape province from 2003 – 2008.

I am hereby pleased to present the *RADAR* report for the Western Cape reviewing disaster incidents and identifying trends between 2003 and 2008. The *RADAR* report is the direct product of the collaborative implementation of the South African and by extension, regional and international policy and governance frameworks governing disaster risk management / reduction within the sustainable development context. Through its multi-sectoral / disciplinary model of implementation, the *RADAR* project serves as a clear demonstration of how the key tenets of Cooperative Governance coined through my department's Service Delivery Value, notably: *Value - Based Change and Transformation – teamwork*, can enhance the achievement of integrated service delivery by combining expertise and resources.

To this end, I wish to express my deepest gratitude to the Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) at the University of Cape Town (UCT), the Publication Advisory Committee (PAC) officials from the National Disaster Management Centre, Western Cape Provincial Disaster Management Centre as well as other sister departments who are hereby acknowledged. "Your hard work and dedication did not go unnoticed"!

I would like to appeal to all disciplines, sectors and levels of government to ensure that they draw policy and implementation lessons from the *RADAR* report and forge the necessary collaborative systems for the implementation of the recommendations of the report, within the development planning processes across all spheres of government.

Mr. Sicelo Shiceka

FOREWORD

by the Western Cape Provincial Minister of Local Government, Environmental Affairs and Development Planning

The Western Cape can be regarded as one of the most disaster prone provinces in South Africa. Since 2006, ten disasters were declared of which the National Disaster Management Centre (NDMC) classified eight as disasters. These disasters included mostly flooding events as well as drought and the displacement of human beings.

It is my pleasure to present the first *Risk and Development Annual Review (RADAR)* publication for the Western Cape. This publication is the first Provincial Disaster Management Centre (PDMC) report detailing disaster events and critical risk reduction issues for a wide range of public sector, emergency services and development planning professionals and practitioners. The project was guided by a Publication Advisory Committee (PAC) consisting of the PDMC, NDMC, Department of Environmental Affairs and Development Planning (DEADP) and the Disaster Mitigation for Sustainable Livelihoods Project (DiMP) at the University of Cape Town (UCT).

During the 2009/10 financial year, the PDMC worked with university partners *to strengthen applied disaster risk scholarship and capacity in the Western Cape*. This initiative foresees a phased collaborative process from 2009 to 2012 that progressively engages the Province's higher education institutions in disaster risk reduction research, as well as formal and non-formal education activities. The project seeks to provide an institutional mechanism that brings together the Cape Higher Education Consortium (CHEC), the PDMC and the four Western Cape higher education institutions in a venture that generates human and institutional capacity to reduce recurrent disaster risks. It also aims at generating provincially relevant applied research outputs in disaster risk science and management.

During 2009 the PDMC obtained funding from the NDMC in order to compile a *RADAR* publication for 2010. This publication aims to provide a consolidated summary of major Western Cape disaster events that occurred between 2003 and 2008. This will enable a wide range of practitioners, both within and beyond the Western Cape, to access post-disaster event analyses and associated data for risk reduction planning purposes. The first edition will focus on the province's changing risk profile – with specific emphasis on severe weather events from 2003 to 2008 and their consequences – and link this with future climate variability and climate change / adaptation. There is a section on the changing urban risk profile, with a reflection on people who were internally displaced in 2008. It is envisaged that future editions will cover other hazards that may cause disasters in the Western Cape.

A special word of thanks to the UCT/DiMP for producing the first scientific publication of its kind in South Africa and for supporting the Western Cape PDMC in its endeavours to make the Province a safer place for all to live in. This surely is an excellent example of pioneering work pertaining to research and it sets the trend for enhancing all aspects of disaster risk reduction and related management initiatives in South Africa.

Anton Wilhelm Bredell

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Acronyms

AIDS	Acquired Immune Deficiency Syndrome www.unaids.org/en/
APRS	Automatic Packet Reporting System http://saweatherobserver.blogspot.com/2008/11/what-is-this-aprs-your.html
CBO	Community Based Organization
CDM	Clean Development Mechanism http://cdm.unfccc.int/index.html
CHEC	Cape Higher Education Consortium www.chec.ac.za/
CoCT	City of Cape Town www.capetown.gov.za/
CoSS	Centres of Safety Sites
DEADP	The Department of Environmental Affairs and Development Planning www.capegateway.gov.za/eng/your_gov/406
DiMP	Disaster Mitigation for Sustainable Livelihoods Programme http://riskreductionafrica.org/
DMA	District Management Area
DOC	Disaster Operations Centre
DRM	Disaster Risk Management www.unisdr.org/
DRMC	Disaster Risk Management Centre www.capetown.gov.za/en/disasterriskmanagement/
DRR	Disaster Risk Reduction www.unisdr.org/
DSD	Department of Social Development www.capegateway.gov.za/eng/yourgovernment/gsc/4190
DWA	Department of Water Affairs www.dwaf.gov.za/
DWEA	Department of Water and Environmental Affairs
Eden DM	Eden District Municipality www.edendm.co.za/
ET	Emission Trading http://unfccc.int/kyoto_protocol/mechanisms/emissions_trading/items/2731.php
EW	Early warning www.unisdr.org/
FBO	Faith-based organisations
FCP	Forward Control Point
GDP	Gross Domestic Product

GHG Greenhouse gas

GIS Geographical Information Systems
www.gis.com/

GPS Global Positioning System
www.mcaggis.co

HFA Hyogo Framework for Action

IDP Internally displaced person
www.unhcr.org/

ISDR International Strategy for Disaster Reduction
www.unisdr.org/

JI Joint Implementation

JOC Joint Operation Centres

LBRC Lower Breede River Conservancy

mill. Million

mm Millimetre

MRA Malagas Residents Association

MSF Médecins Sans Frontières
www.msf.org/

NDMC National Disaster Management Centres
www.ndmc.gov.za/

NDMF National Disaster Management Framework
http://web.ndmc.gov.za/Framework.htm

NGO Non-Governmental Organisation

NIA National Intelligence Agency

NSRI The National Sea Rescue Institute
www.nsri.org.za/

ODM Overberg Disaster Management

Oxfam www.oxfam.org/

PAC Publication Advisory Committee

PDMC Provincial Disaster Management Centres

RADAR Risk and Development Annual Review

RF Radio frequency

SAFFG South African Flash Flood Guidance

SanParks South African National Parks
www.sanparks.org/

SANRAL South African National Roads Agency Limited
www.nra.co.za/live/index.php

SARCS	South African Red Cross Society www.redcross.org.za/
SAWS	South African Weather Service www.weathersa.co.za
SLP	Sea Level Pressure
TAC	Treatment Action Campaign www.tac.org.za/
UCT	University of Cape Town www.uct.ac.za/
UN	United Nations www.un.org/
UNFCCC	United Nations Framework Convention on Climate Change http://unfccc.int/
UNHCR	United Nations High Commissioner for Refugees www.unhcr.org/
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
USA	United States of America
VHF	Very high frequency

Introducing *RADAR*

The Western Cape is well known for its stormy weather, wildfires, harsh droughts and many different types of flood. Over recent years, severe storms have led to hardship, as well as damaged homes, infrastructure and farms. These disasters have also diverted resources from other urgently needed services.

The period covered by this first issue of *RADAR* coincides with the promulgation of the Disaster Management Act in January 2003. It chronicles a transition in disaster risk reduction, as municipalities began to improve their risk management capabilities. *RADAR* also highlights new forms of co-operation, such as the increasingly effective partnership between the South African Weather Service and the province's municipal and provincial disaster management centres.

The publication chronicles 12 disaster events that occurred between 2003 and 2008 (see Table 1). However, it goes beyond an exercise in 'counting costs', instead highlighting the underlying conditions that either contributed to damage or, in some cases, reduced the severity of impacts. These important lessons can help improve our understanding of geographic areas, sectors and households that are particularly prone to severe weather and flood risks, as well as of those that are more risk-averse.

By sharing these insights from across the province, we hope that *RADAR* can help to advance risk management efforts in our famous 'Cape of Storms'.

Damage sustained by the railway bridge following the 1981 Laingsburg floods when the Buffels River flooded, claiming more than 100 lives.

Table 1 Summary of significant disaster events from 2003 to 2008 in the Western Cape Province, South Africa (excluding fires)

Dates	Event Type	Area affected (district, municipality/ metropole)	Social impacts	Direct damage costs (R mil)	Direct damage costs * (R mil)
March 2003	Cut-off low	Cape Winelands, Eden and Overberg District	2,000 people evacuated Three deaths in Hermanus and Knysna	212.4	238.3
August 2004	Two large cold fronts preceded by gale force winds and severe rain storm	City of Cape Town	20,000 informal residents flood affected	6.5	5.1
December 2004	Cut-off low	Cape Winelands, Eden and Overberg District	3,700 homes and 40 business premises damaged	54.9	57.9
April 2005	Cut-off low	Cape Agulhas Municipality	Residents of Kleinbegin flood affected	8.9	8.9
August 2006	Two cut-off low systems	Cape Winelands, Eden, Overberg and Central Karoo District	1,200 people displaced	510.5	479.2
November 2006	Hailstorm	Haarlem	Seven farms: 389 hectares of fruit trees damaged; 35 small traders, 194 permanent & 160 temporary workers unemployed	9.4	6.6
June 2007	Two rainfall events: A cut-off low, followed by a mid-latitude cyclone	West Coast and Cape Winelands District	People from low cost housing, informal settlements and farms evacuated	128.3	111.3
November 2007	Cut-off low associated with black southeaster	Cape Winelands, Overberg, Central Karoo and Eden District	Over 300 people from low cost housing, informal settlements and farms either provided with relief or evacuated; two fatalities	957.6	830.9
May 2008	Social violence (xenophobia)	City of Cape Town and Eden District	20,000–22, 000 foreign nationals displaced. Two to four people killed	Approx. 200	
July 2008	Cut-off low and strong south easterlies	West Coast District		71.7	57.0
August 2008	Severe storm	City of Cape Town	Coastal property damaged and extensive flooding of areas with inadequate drainage	4.9	2.9
November 2008	Cut-off low associated with black southeaster	Overberg, Cape Winelands and Eden District		996.0	791.3

** Adjusted for inflation, equivalent to 2005 values*

1.1 Who should read *RADAR*?

RADAR has been developed for a wide range of development and disaster risk management professionals and practitioners. These include (but are not limited to) the groups listed in Table 1.1.1.

Table 1.1.1 Practitioners and professionals for whom *RADAR* is relevant

Practitioner and Professional Group	Why *RADAR* is relevant
Disaster risk management practitioners and fire fighters	The central role of disaster risk management professionals in the Western Cape is to manage disaster risks, and to reduce losses during disaster incidents. Many of the lessons learned from the storms described in *RADAR* will improve management of current climate risks. They could also improve capacity to manage future change.
Civil and water engineers, integrated and spatial development planners	Post-impact reports show the roles that engineering and development planning play as front-line and strategic climate risk management services. This is because they are able to reduce many of the exposure factors for flood and severe weather loss. Robust technical and engineering services are particularly critical in severe weather- and flood-exposed municipalities. These services are critical for upgrading infrastructure. For example, research shows that litter, solid waste and vegetative debris repeatedly block stormwater drains and natural water courses. This contributes to blockages, and increases the chance of flood damage and infrastructure failure. Extreme weather events can also bring considerable hardship to poor families. Many of these risks are the result of unplanned homes in low-lying or naturally flood-prone areas. They are also due to low-cost formal settlements that have not been sufficiently flood-proofed.
Development, agricultural and public sector economists, as well as insurance professionals and international agencies	*RADAR* provides the first spatially-referenced account of severe weather and flood damage sustained by public sector entities in the Western Cape. It highlights sectors and locations that are particularly at-risk, and provides an overview of cumulative damage costs from repeat events.
Housing and human settlement planners	From a disaster risk perspective, housing is both an asset and a hazard for many residents of low-cost formal and informal homes. Housing is often the most valuable asset for poor families – but because of their location and poor construction, poorly-built low-cost formal and informal homes themselves constitute a significant hazard.

Table 1.1.1 (Cont...)

Practitioner and Professional Group	Why *RADAR* is relevant
Primary health care workers	Health impacts on young children increase following heavy rain events and include respiratory, diarrhoeal and skin conditions. This has been observed often and is repeatedly reported in informal settlements and low-cost formal housing areas though it may not be documented in clinic records.
Social services and health practitioners	The poorest households are those that settle in the most at-risk areas, and experience proportionately greater losses following severe weather or heavy rains.
Teachers, adult education and training practitioners	*RADAR* is a useful teaching resource for high school geography and life orientation as it illustrates relationships between weather, flooding and social development in the Western Cape. *RADAR* is also particularly relevant to adult educators interested in working in a participatory way with practitioners and community residents in challenging development contexts.
Community-based and non-governmental organisations	CBOs and NGOs involved in either single-sector or integrated development projects may find *RADAR* useful for incorporating either a 'risk perspective' (or lens) into their ongoing planning, or a participative approach into their or development efforts.

1.3 How was *RADAR* developed?

RADAR was developed between 2009 and 2010 by UCT/DiMP, following the completion of extensive research on six years of severe weather events and social violence in the Western Cape. The maps, tables and other information presented here represent almost ten years of focused 'ex-post' or post-disaster research in the Western Cape, and have been derived from post-disaster studies commissioned by provincial and national government, as well as by the City of Cape Town (CoCT).

Findings have also been drawn from post-graduate Disaster Risk Science research at the University of Cape Town (UCT). The data, arguably the best in South Africa, have been supplied by provincial departments and directly from municipalities, and have been carefully verified and cross-checked. It is estimated that at least 35 individual UCT-based researchers contributed to the results presented in *RADAR* over an eight-year period.

This review was also significantly informed by a publication advisory committee, comprising representatives from two provincial departments as well as the National Disaster Management Centre (NDMC). It was circulated for extensive review, with changes being formally incorporated in early 2010.

1.3.1 Are there limitations to the data used?

The information in *RADAR* is derived from municipal and provincial reports, interviews and, in nine of the storm events, actual field research. However, it is constrained by protracted lag times between the occurrence of the events and the provision of funding for post-impact research. This has happened despite the recurrent and costly nature of the storms, and the fact that such studies are explicitly required by both the national and provincial disaster management frameworks. UCT has attempted to fill this gap by encouraging post-graduate research on specific storm events, so that baseline information on dates, losses, rainfall magnitude and other institutional details are captured and consolidated.

The absence of uniform systems for recording and geo-referencing impacts has also limited the accuracy of the data. This is especially the case when 'institutional memory' has been affected by turnover of key municipal and provincial personnel, combined with the unrelenting demands of wildfires, informal fires, droughts, road traffic accidents and other emergencies in many of the same areas.

In addition, *RADAR* can only accurately profile direct damage costs sustained and reported primarily by public sector entities. The exception to this is farm damage costs reported to the Provincial Department of Agriculture. Unfortunately, the losses reported by farmers have not been independently verified, thus limiting the accuracy of this information.

Lastly, the impact information reported here is limited to the directly recorded cost of damage. It was simply not possible to examine indirect impacts or secondary impacts of the storm events and floods, although the research team recognises the need for this research. These different types of economic impact are described in the following pages.

How do we measure the economic impact of severe weather events?

'Counting the costs' of severe weather and endangering floods is very difficult. This is because there are direct and indirect effects that are borne by the public and private sectors, as well as by individuals. These effects can be dispersed over large areas. They can also unfold over days, months and even years, making them difficult to measure. In addition, severe weather can bring benefits, such as reinvigorated ecosystems and replenished dam storage levels.

It is recognised that there are specific terms used in disaster loss economics [1], [2], [3]. However, the financial data in *RADAR* refer only to *tangible direct damage to property*, sustained primarily by public sector entities and private farms. These terms are defined as follows:

- *Tangible* effects refer to losses which can be assigned a monetary value
- *Direct effects* include damage or destruction to physical assets, or even loss of life. This category only represents damage to "assets that occurred at the time of the actual disaster. The main items in this category include the total or partial destruction of physical infrastructure, buildings, installations, machinery, equipment, means of transportation and storage, furniture, damage to farmland, irrigation work, reservoirs and the like. In the special case of agriculture, the destruction of crops ready for harvest must also be valued and included."[4]

Definition Figure 1 Example of road damage directly attributable to the November 2007 cut-off low (Source: *The Herald* (Garden Route edition), Tuesday 27 November, 2007)

Following the November 2007 cut-off low, heavy rains and flooding caused the main road to collapse between St Francis Bay and Cape St Francis. This is an example of a direct tangible effect of a severe storm.

Due to lack of consistent and available data, *RADAR* does not report on *intangible effects*, *indirect losses* or *macro-economic effects*. These can be explained as follows:

- *Intangible* effects are those which cannot be assigned a monetary value; for instance, the suffering and hardship that comes with sleeping in damp homes, the anxiety generated by the loss of employment or the loss of assets with historic value, all of which may be just as important as tangible losses
- *Indirect losses* refer to disrupted flows in the production of goods and services as a result of knock-on effects from direct property damage. These consequences of damage are sometimes distinguished as “first-order” losses or “second (higher) order” losses
  - Indirect *first order economic losses* include, for example, the cost of disrupted functioning of sewage treatment plants due to flood damage or disrupted trade because of a collapsed bridge
  - Indirect *secondary or higher order economic losses* unfold over longer periods, for example a marked increase in young children requiring treatment for lower respiratory infections such as pneumonia and bronchitis compared to the previous year, because of the protracted dampness of low-cost and informal homes in the affected areas
- *Macro-economic effects* refer to the performance of the main macroeconomic aggregates of an affected country, for example the impact on inflation, gross domestic product (GDP) etc when taking total economic impacts into account

Definition Figure 2 Example of direct and indirect disaster effects, illustrated by the destruction of the Choo-tjoe train tracks (Photograph by Wayne Holzhausen)

Following the August 2006 Southern Cape Compound Disaster, the Choo-tjoe rail link was damaged as shown above. This had negative ‘knock-on’ or indirect effects *on tourism in the Southern Cape.*

1.4 How is *RADAR* organised?

RADAR is organised into seven main sections.

Chapter 1

Introducing RADAR
Chapter 1 provides important background information for readers, including an overview of the scale and duration of the research.

Chapter 2

Cabo das Tormentas
This chapter reviews storms that significantly affected more than one district municipality – or that would be considered 'transboundary' events.

Chapter 3

Municipalities bear the brunt
Chapter 3 reviews storms and flood events which had impacts primarily in one municipality. These include large storms that affected the City of Cape Town.

Chapter 4

A complex urban disaster: The social violence of 2008
This chapter profiles the xenophobic violence of 2008 – a traumatic 'human-induced storm' that placed serious and prolonged demands on relief agencies, especially in the City of Cape Town

Chapter 5

When storms collide
Chapter 5 uses a two-map sequence to show how naturally-triggered threats collided with human-induced pressures in the City of Cape Town in 2008.

Chapter 6

Emerging resources – linking up with local movers and shakers
This chapter provides a snapshot of emerging risk management capabilities, driven by committed and skilled individuals in communities across the province.

Chapter 7

From counting costs to protective planning
This chapter provides a detailed summary of costs from storm and flood damage across all spheres of government, from 2003 to 2008. It highlights that severe storms are not rare events, and that the management of climate risks should be a central part of integrated development planning.

A **CD version** of *RADAR* is provided with the book.

1.5 How to use *RADAR*

This publication should be used to support risk reduction planning efforts in risk-prone areas, especially those exposed to severe storms and where there are recurrent flood losses. *RADAR* combines a wide range of maps, damage cost tables and photographs to profile areas and sectors that are particularly at risk – as well as those that have sustained repeat losses. It has been organised so that readers can choose to focus on specific storm events, or review recurrent damage costs over time as these apply to different public sector entities.

1.5.1 How to interpret the tables

RADAR contains a number of different tables. Chapters 2 and 3 provide summary tables for each severe weather event that consolidate key information on storm dates, rainfall magnitude and public sector damage costs. Chapter 7 provides detailed information on reported public sector damage, adjusted for inflation to 2005 values. This has been consolidated over time for national, provincial and municipal spheres.

1.5.2 How to interpret the maps

There are numerous maps in this book. They serve multiple purposes as described in Table 1.5.2.1.

Table 1.5.2.1 Descriptions of maps in *RADAR*

Chapter	Type of Maps	Maps represent the …
2	Reported direct municipal damage costs across all affected municipalities (in R million)	…extent and cost of municipal damage reported in each transboundary event
3	Suburbs or areas affected by each severe weather even	…spatial extent of reported municipal damage in one town or city
4	Reported instances of social violence in the City of Cape Town in 2008, and location of community refuges	…dispersed nature of the social violence emergency in the City of Cape Town. This includes the extent of civil society response
5	Two-map sequence for City of Cape Town illustrating spatial extent of displacement and severe weather / flooding between May and August 2008	…combined effects of social violence and severe weather/flooding, which created exacting demands across the city
6	Thumbnail maps of the Western Province, highlighting specific locations of the organisations described	…specific location of towns where local risk management efforts are taking place
7	Sectoral maps showing reported damage	…location of Department of Water Affairs gauging stations that have repeatedly failed and farms in Swellendam that reported flood damage in 2007/8

1.5.3 Where are the definitions of key terms?

Managing climate risks in the Western Cape is a cross-sectoral undertaking. This requires an understanding of terms drawn from quite different disciplines. *RADAR* defines a wide range of relevant terms in two-page 'definition' sections in each chapter. These sections are easily identified by tinted pages in Chapters 1, 2 and 3.

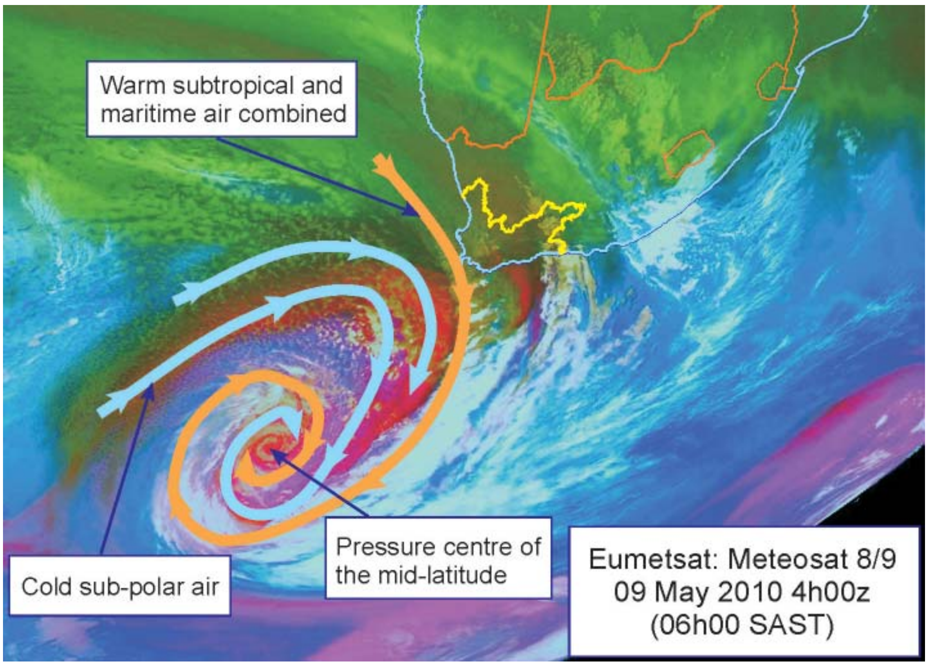
The chapter locations of terms explained in *RADAR* are summarised in Table 1.5.3.1.

Table 1.5.3.1 Chapter locations of terms defined in *RADAR*

Chapter	Definitions focus on…	Terms Covered
1	Disaster loss estimation	Direct and indirect economic effects, tangible and intangible effects
2	Severe weather	Cut-off lows, mid-latitude cyclones, cold fronts Early warning, severe weather and flood warning systems, South African Flash Flood Guidance (SAFFG) system Disaster risk management, disaster risk reduction (DRR)
	Climate change and adaptation	Climate change Adaptation to climate change
3	Flood types in the Western Cape	Flash floods, river floods, rising floods and storm surges
	Early warning and disaster risk management	Convection, convection thunderstorms 'Superstorms', severe storms, microbursts, tornadoes

1.5.4 The *RADAR* cover image

Figure 1.5.4.1 *RADAR*'s cover illustrates a powerful mid-latitude cyclone that passed very close to Cape Town on 10 May 2010



The unusual spiralling cloud pattern into the intense pressure centre of this mid-latitude cyclone is the result of highly energetic, fast-moving, warm as well as sub-polar air. Thankfully, the system passed quickly, with locally reported wind damage but limited flood impacts.

To sum up...

- *RADAR* is an applied research response to recent storms that have battered the Western Cape in recent years and which have proved costly for the municipalities and provincial departments affected
- It chronicles twelve of these events from 2003 to 2008, going beyond an exercise in counting costs, to highlight underlying risk factors that either contributed to damage or reduced the severity of impacts
- The period covered also coincides with the promulgation of the Disaster Management Act in January 2003. It marks a transition in disaster risk reduction capacity across much of the province, as many municipalities began to realise the benefits that come with improved risk management
- *RADAR* has been developed for a wide range of development and disaster risk management professionals and practitioners, and is intended to be a flexible resource that can be applied in numerous contexts
- *RADAR* was developed so that readers can choose the sections and chapters that are most relevant to their interests and area of responsibility
- It is written in both Afrikaans and English and has seven chapters. It is also accompanied by a CD version and is web-enabled on www.ndmc.gov.za, www.capegateway.gov.za/pdmc and www.riskreductionafrica.org

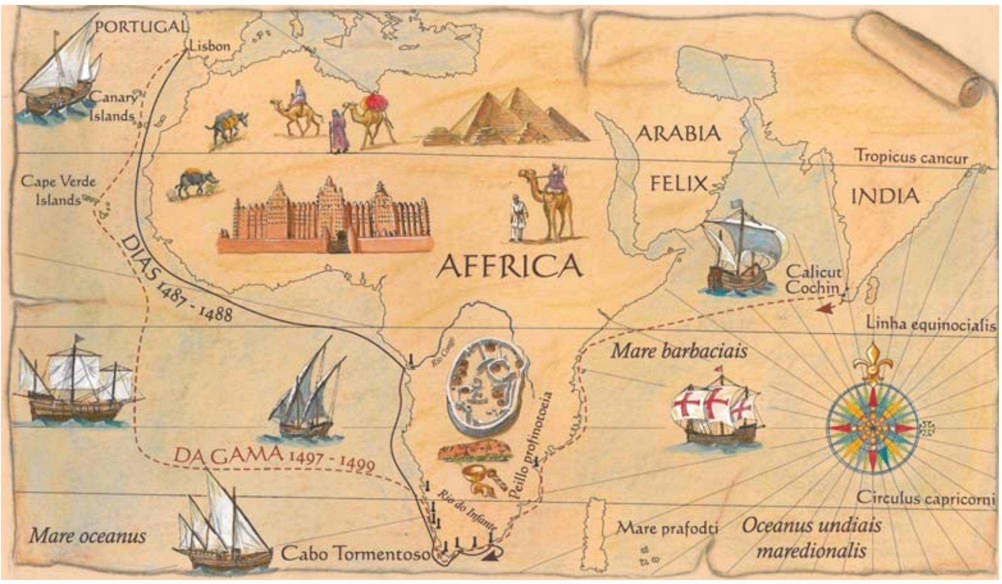
Cabo das Tormentas

Cape of Storms
Die Kaap van Storms
Ikapa Iendudumo

We have called the Western Cape 'The Cape of Storms' for more than 500 years, ever since Bartholomeu Dias first named it 'Cabo das Tormentas'. The Cape continues to live up to this stormy reputation, with more than 100 lives lost in the 1981 Laingsburg floods. And, in August 1999, the 'Manenberg tornado' swept through several Cape Town neighbourhoods, leaving a trail of destruction and 5,000 people homeless.

This chapter chronicles six severe transboundary weather events that affected more than one municipality or district, from 2003 to 2008. It focuses particularly on the costly cut-off low weather events that have resulted in more than R2.5 billion (adjusted to 2005 values) in property and infrastructure damage across the Western Cape. In recent years, these weather systems have had a large impact on the province's growing cities, coastal settlements and rural communities, and have emerged as a significant developmental challenge.

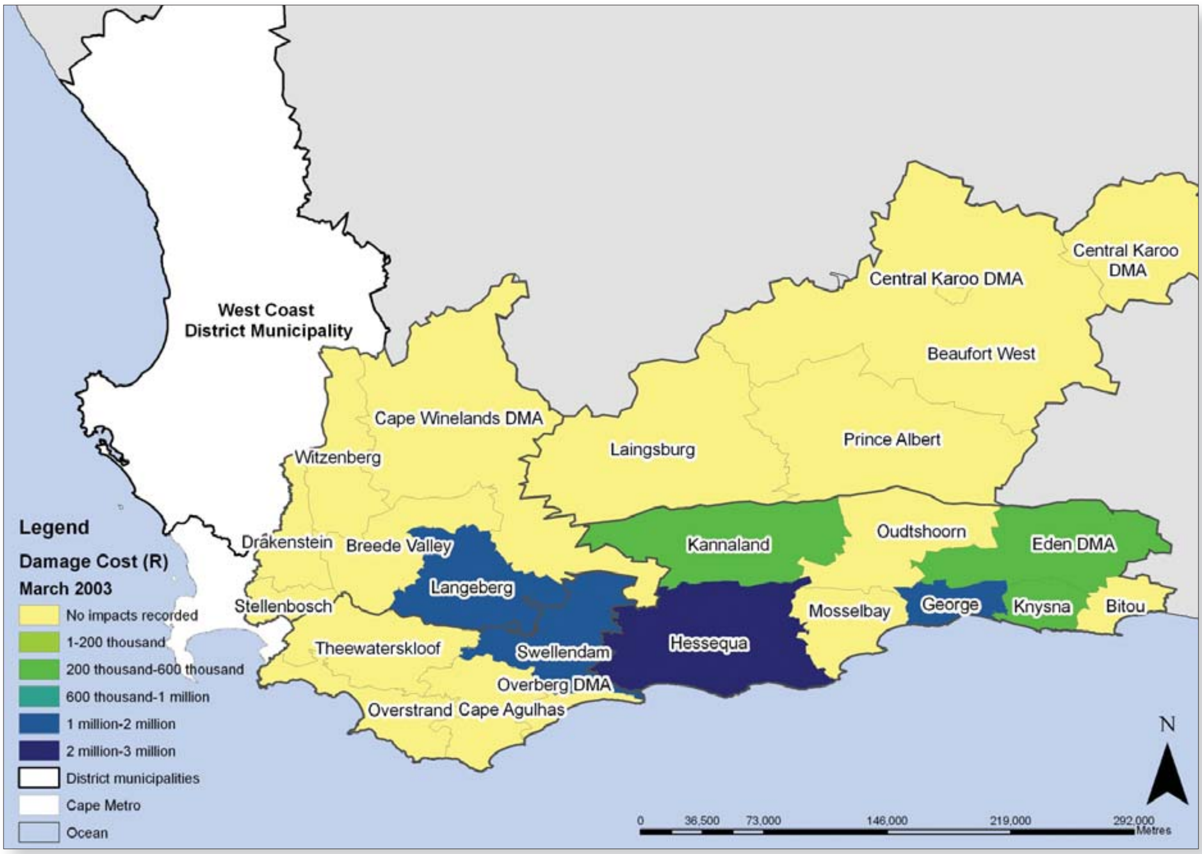
Chapter 2 also profiles a province facing new risks, as its urban centres and other developments push back into fragile ecological zones in river valleys, in mountain catchments and along the coast. When these risks develop into 'realised' events, such as flash floods, they come with developmental costs. The sections that follow reveal the developmental challenges posed by these complex 'storms' of both natural and human origin.



Map showing the fifteenth century voyages of Bartholomeu Dias and Vasco Da Gama. In 1488, Dias became the first European explorer to reach the Cape, which he named "Cabo das Tormentas'. His landfall sites are indicated by the symbol.

2.1 March 2003 – 'Montagu floods'

Map 2.1.1 March 2003 cut-off low – direct municipal damage costs



March 2003 – 'Montagu floods'	
Dates	22–25 March 2003
Areas affected	Cape Winelands, Overberg and Eden Districts
Heaviest daily rainfall	Montagu, 23 March, 178 mm
Heaviest total rainfall	Montagu, 23–25 March, 241 mm
Social impact	Three deaths (two in Hermanus and one in Knysna), 86% increase in lower respiratory infections in < 5-yr-olds
Direct total damage costs (unadjusted 2003 values)	R212.4 million
Direct total damage costs (inflation adjusted 2005 values)	R238.3 million
Direct municipal damage costs (unadjusted 2003 values)	R6.9 million
Direct municipal damage costs (inflation adjusted 2005 values)	R7.8 million
URL for report	www.riskreductionafrica.org

March 2003 – 'Montagu floods': What happened?

On Thursday 20 March 2003, before the long weekend to celebrate Human Rights Day, the South African Weather Service (SAWS) issued its first weather advisory about a powerful approaching weather system. This system developed into an intense cut-off low after making landfall on 22 March, eventually sweeping across the south coast and adjacent interior.

A day after the system made landfall, 178 mm rain were recorded in 24 hours by the SAWS rainfall station in Montagu. This, the highest daily value recorded for Montagu in 23 years, led to riverine flooding and severe rain damage to infrastructure, commercial farms and hundreds of low-income homes. It also resulted in the evacuation of more than 500 families in Montagu as well as the local primary school.

Floodwaters surging down the Kingna and then the Keisie River severed the critical 11 km road link between Ashton and Montagu known as the Kogmanskloof Pass. The resulting road damage disrupted tourist access to the week-long Klein Karoo National Arts Festival, scheduled to begin on 28 March.

This extreme weather system, which extended more than 800 km, moved overland to the east until 25 March, bringing continued rainfall, gale-force winds and very low temperatures. In its wake it left: damaged provincial road infrastructure valued at R15.6 million in the Eden District Municipality; a disabled sewage treatment plant in Heidelberg; disrupted electricity supply in Kannaland; and widespread farm losses, including thousands of livestock death. In Hermanus, two women died when a strong wave swept them out to sea and in Knysna, a man lost his life when a tree blew over and crushed him.

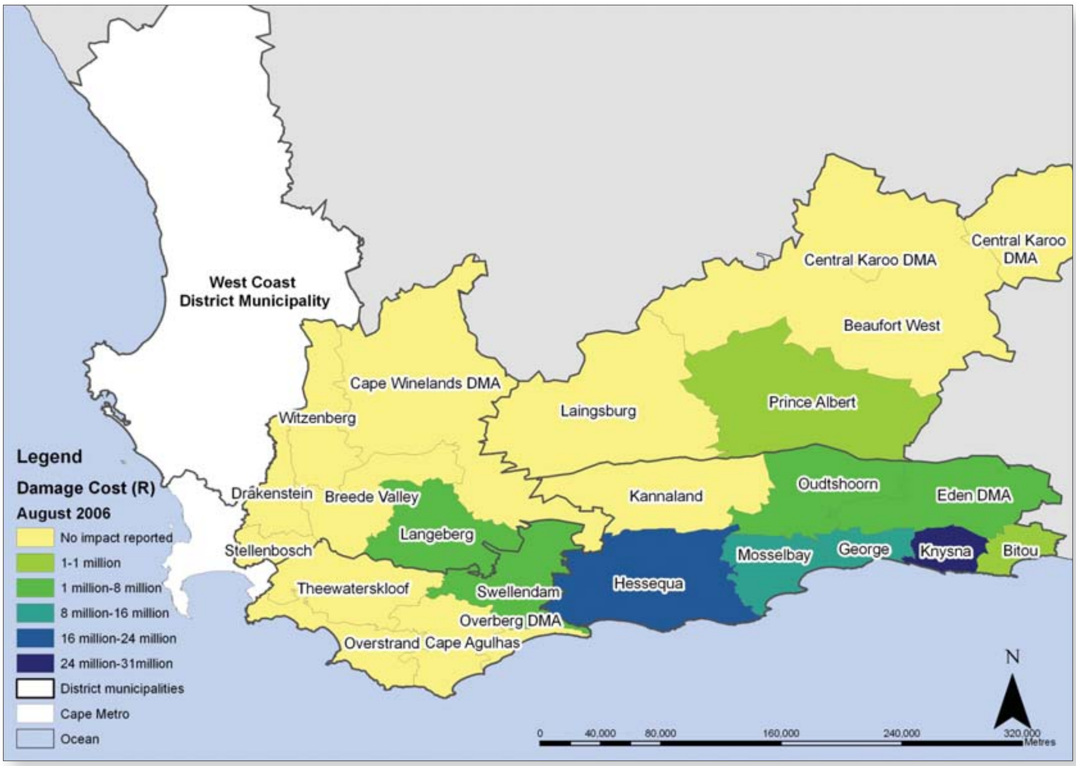
A silent and creeping impact in affected areas of the Cape Winelands and Overberg two months later was an 86% increase in the number of young children with lower respiratory infections, compared to the previous year.

Did you know?

- It cost R66.2 million (75% of all losses to the Department of Provincial Roads) to repair the 11 km of damage in Kogmanskloof Pass
- Over 380 farms reported losses valued at R100.5 million
- Twelve primary and secondary schools sustained roof damage due to heavy rain

2.2 August 2006 – Southern Cape compound disaster

Map 2.2.1 August 2006 cut-off lows: direct municipal damage costs



August 2006 – Southern Cape compound disaster	
Dates a) Cut-off low 1 b) Cut-off low 2	 31 July–4 August 21–24 August
Areas affected	Cape Winelands, Overberg, Eden and Central Karoo Districts
Heaviest daily rainfall a) Cut-off low 1 b) Cut-off low 2	 George, 1 August, 230.1 mm Swellendam, 23 August, 80 mm
Total heaviest rainfall a) Cut-off low 1 b) Cut-off low 2	 George, 327.8 mm Swellendam, 124 mm
Social impact	1,000 people temporarily displaced
Direct damage costs (unadjusted 2006 values)	R510.5 million
Direct damage costs (inflation adjusted 2005 values)	R479.2 million
Direct municipal damage costs (unadjusted 2006 values)	R103.7 million
Direct municipal damage costs (inflation adjusted 2005 values)	R97.4 million
URL for report	www.riskreductionafrica.org

2006 – Southern Cape compound disaster: what happened?

In August 2006, two cut-off low weather systems spaced three weeks apart struck the Southern Cape. This means that the compound disaster we call the 'August 2006 floods' actually refers to two cut-off lows, the first of which occurred from 31 July–4 August and the second from 21–24 August.

On 31 July, a large cold front made landfall over the Southern Cape, becoming a cut-off low the following day. The heaviest rainfall in the Western Cape over the five-day event was recorded in George (327.8 mm), while in the Eastern Cape, Humansdorp reported a total of 357 mm, with rainfall on 2 August alone reaching 302 mm.

The second cut-off low was centered further inland than the first, with Swellendam and Robertson recording significant rainfall (124 mm and 109 mm respectively). Once again, George recorded serious rain – 111.7 mm over the four days.

The direct cost of the damage from these two storms was estimated at approximately R479.2 million. In addition, the storms resulted in severe hardship to residents of low-cost formal and informal housing. In the case of the low-cost formal housing, it was also clear that the houses bore the brunt of surface run-off from roads that had shallow drains and inadequate stormwater capacity.

This compound disaster highlighted the Eden District's exposure to climate risks once again. It also drew attention to the on-the-ground risk factors that increase the likelihood of flood and storm damage. These included recent rapid urban growth in the Southern Cape that has hardened river catchments, increasing surface runoff. Other factors included under-investment in municipal maintenance and provincial roads, and in protective stormwater systems. This was most spectacularly demonstrated by the slope failure, rock-falls and mud slides on the Kaaimans River Pass on the N2 highway, between George and Wilderness. Reconstruction of this critical transport link cost more than R82.4 million, excluding indirect costs resulting from disrupted trade and transport.

Did you know?

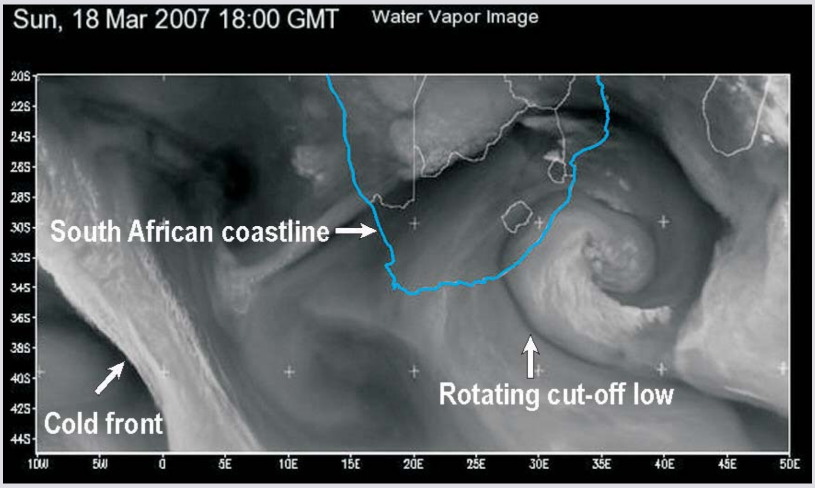
- Heavy vehicles diverted from the Kaaimans River Pass to the Langkloof Road had to drive an extra 400 km
- Over 60 sections of provincial roads that failed in the 'Montagu floods' of 2003 were damaged again in 2006, totalling R35.5 million in repeat repair costs
- George's overall urban area increased 600% from 15km^2 in 1985 to 90km^2 in 2004
- Cut-off low weather systems are not the same as cold fronts

What is a 'cut-off' low?

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.

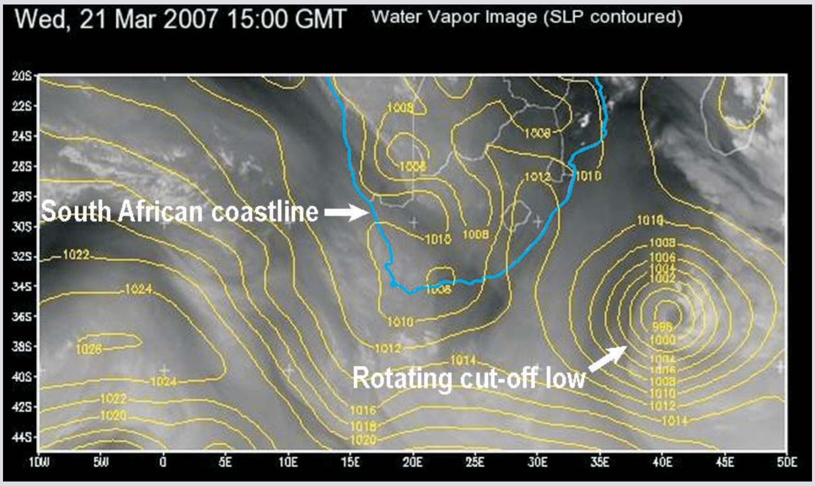
Cut-off lows are associated with very strong atmospheric instability and powerful convection updrafts. They also bring a range of severe types of weather, including torrential rainfall, snow in mountainous areas and violent winds. Cut-off lows are one of the main drivers of damaging floods in South Africa, and can also trigger thunderstorms.

Definition Figure 3 Water vapour image of South Africa, 18 March 2007



This photograph clearly shows how cut-off lows rotate and how they differ from cold fronts (a cold front is approaching from the west). The image shows how the cut-off low has been cut off from the main westerly flow, while the cold front is still a part of it.

Definition Figure 4 Water vapour image; Sea Level Pressure (SLP) contoured for South Africa, 21 March 2007



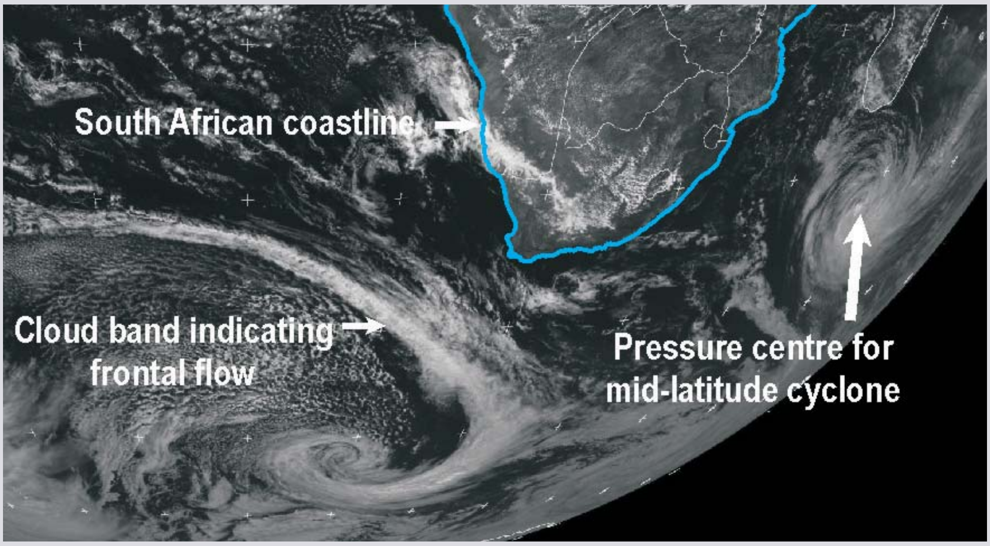
This is the same image as the one above, but three days later and this time with pressure contours shown. It illustrates the cut-off low's cellular nature and the fact that it has hardly moved.

What is a mid-latitude cyclone? Is it the same as a cold front?

A mid-latitude cyclone is a low pressure system that originates in the mid-latitudes and travels eastwards. These systems are mainly responsible for the Western Cape's winter rainfall. They consist of a cold mass of air or 'cold front', ahead of which warmer air is forced to rise, making the atmosphere unstable. When conditions are unstable, clouds can form, leading to rain.

Cold fronts are associated with mid-latitude cyclones. The cold front represents the leading part of the advancing mass of cold air circulating around the mid-latitude cyclone where it pushes up the warmer air ahead of the cold front, causing heavy cloud cover and rainfall.

Definition Figure 5 Infrared satellite image of a mid-latitude cyclone approaching South Africa from the west, 20 February 2007



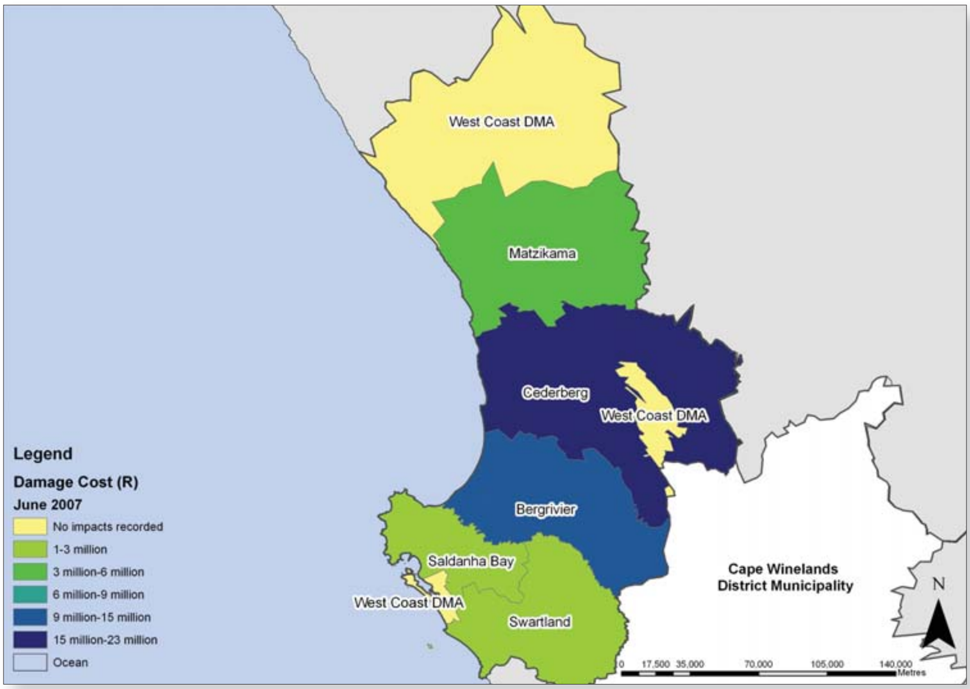
This is what a mid-latitude cyclone looks like from space. You can see the low pressure centre where the cloud spirals inwards. The band of cloud approaching South Africa represents the frontal zone of the system (in other words, the 'cold front' refers to the region between the cold mass of air behind it, and the warm air ahead of it).

All weather systems are due to differences in pressure. In the Southern Hemisphere, low-pressure systems are characterised by rising air and cyclonic rotation (anti-cyclonic in the Northern Hemisphere). However, they are usually associated with an unstable atmosphere, which often leads to cloud formation and rainfall. This means that all stormy weather, such as violent winds, heavy rain, and even lightning and hail, is usually the result of a localised low-pressure area.

Many of the Western Cape's most damaging weather events reflect the combined impact of two or more weather systems that occur close together. This was clearly illustrated in June 2007 when two weather systems, including a cut-off low, buffeted the West Coast in a period of just over two weeks causing damage costing more than R100 million in repairs.

2.3 June 2007 – West Coast floods

Map 2.3.1 June 2007 cut-off low and mid-latitude cyclone: direct municipal damage costs



June 2007 – West Coast floods	
Dates a) Cut-off low and cold front b) Mid-latitude cyclone coupled with a second cold-front	6–11 June 2007 25–26 June 2007
Areas affected a) Cut-off low and cold front b) Mid-latitude cyclone coupled with a second cold-front	West Coast District West Coast and Cape Winelands District
Heaviest daily rainfall a) Cut-off low and cold-front b) Mid-latitude cyclone coupled with a second cold-front	Bergrivier Municipality, 6 June, 130 mm Witzenberg Municipality, 25 June, 40 mm
Heaviest total rainfall a) Cut-off low and cold-front b) Mid-latitude cyclone coupled with a second cold-front	Bergrivier Municipality 280–318 mm Witzenberg Municipality, 50 mm
Social impacts	Three deaths
Direct damage costs (unadjusted 2007 values)	R128.3 million
Direct damage costs (inflation adjusted 2005 values)	R111.3 million
Direct municipal damage costs (unadjusted 2007 values)	R50.0 million
Direct municipal damage costs (inflation adjusted 2005 values)	R43.4 million
URL for report	www.riskreductionafrica.org

June 2007 – West Coast floods: what happened?

On 1 June 2007, the South African Weather Service (SAWS) informed both the national and provincial Disaster Management Centres of an approaching cold front. Four days later SAWS updated its initial forecast, warning of an imminent extreme weather event that would involve *two* cold fronts.

The combined effects of the two weather systems – a cold front that intensified into a cut-off low, and a mid-latitude cyclone resulted in severe flooding across the West Coast. Flood damage, particularly to municipal, provincial and national infrastructure, was estimated at R111.3 million, with Transnet sustaining 27% of damage costs. The deaths of three people and several injuries due to weather-related road accidents were also attributed to the severe weather.

The first event (6–11 June) was caused by a cut-off low-pressure system producing strong frontal features with it as it passed over the Western Cape. This led to prolonged heavy rain, with the highest daily rainfall of 130 mm recorded on 6 June in the Bergrivier Municipality.

The second event (25–26 June) was caused by a mid-latitude cyclone supported by a deep upper air trough cold front. This system caused extensive flooding, as it also passed over the Western Cape. The rainfall for this second system was lower, with a highest daily rainfall of 40 mm recorded on 25 June in Witzenberg.

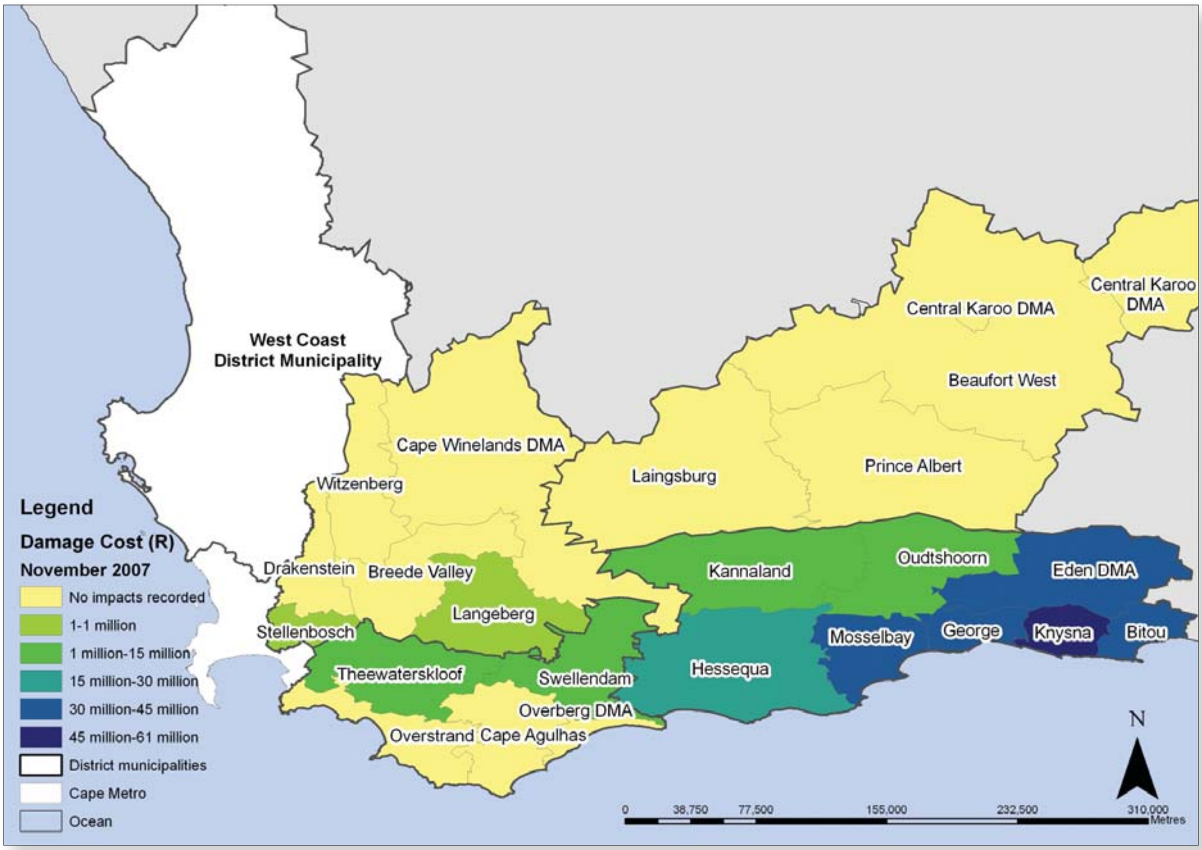
The prolonged heavy rains caused all affected Department of Water Affairs (DWA) dams to overflow. It also led to widespread damage and the subsequent closure of roads. The most severely affected areas were the low-lying areas and southern parts of the region, especially the towns of Moorreesburg, Hopefield, Vredenburg and Citrusdal.

Did you know?

- Saldanha Bay was the only municipality that did not sustain damage to its water supply
- Seven schools reported roof damage, primarily because of heavy rain and wind
- All municipalities should have emergency contingency plans with clear procedures for warning local residents, businesses and other stake-holders
- Farmers need to receive severe weather and flood warnings with enough time to move livestock, irrigation equipment and pumps away from flood-prone rivers

2.4 November 2007 – Southern Cape floods

Map 2.4.1 November 2007 cut-off low: direct municipal damage costs



November 2007 – Southern Cape floods	
Dates	19–24 November 2007
Areas affected	Cape Winelands, Overberg, Eden and Central Karoo Districts
Heaviest daily rainfall	George, 21 November, 297.4 mm
Heaviest total rainfall	George, 458.8 mm
Social impacts	Rescue, evacuation, sheltering of about 1,500 people displaced by the flooding (mostly from informal settlements, low-cost housing and rural areas)
Direct damage costs (unadjusted 2007 values)	R957.6 million
Direct damage costs (inflation adjusted 2005 values)	R830.9 million
Direct municipal damage costs (unadjusted 2007 values)	R305.5 million
Direct municipal damage costs (inflation adjusted 2005 values)	R265.0 million
URL for report	www.riskreductionafrica.org

November 2007 – Southern Cape floods: What happened?

From 19–24 November 2007, the South Western Cape was buffeted by yet another cut-off low that led to flooding in four districts. This constituted the fifth such event to hit the Eden District since 2003. Flood impacts were experienced first in the Overberg, then in the Cape Winelands and Central Karoo, with Eden being the last district affected. Unsurprisingly, many of the same areas that had borne the brunt of the August 2006 storms were badly affected by this event. And once again, the storm and flood damage was considerable, with estimated direct damage costs of R793.5 million.

New rainfall records were set across the province from the Jonkershoek Valley to George. For instance, the Jonkershoek Valley received the highest recorded monthly rainfall in 30 years, with 70% of this falling from 20–22 November. Similar values were recorded as far away as Mossel Bay and George, as the cut-off low moved along the coast.

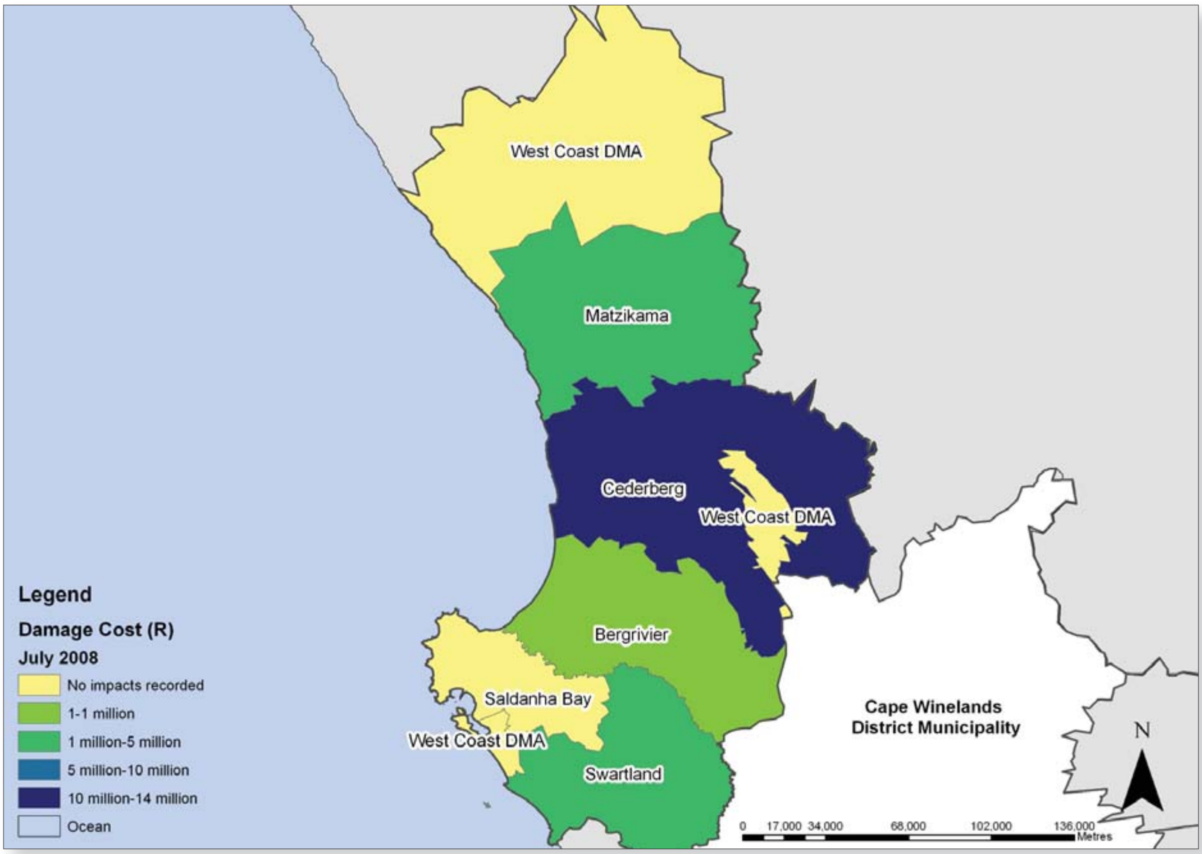
However, despite the record-setting rainfall, this storm's effects were far better anticipated and managed than those in 2005 and 2006. This was due to the much stronger co-operation between the Joint Operation Centres (JOC), the SAWS, DWA and the communities themselves. It also showed that many of the lessons learned from previous storms had indeed been taken seriously – especially the importance of early warnings provided by the SAWS.

Did you know?

- Municipalities in the Western Cape have improved their capacity to respond when a severe storm is forecasted...
- ...they could do even more to control flood risk factors, such as maintaining stormwater systems, weather-proofing low-cost housing and removing debris from drains and river banks
- The Overberg District JOC used ArcGIS to improve disaster response. This meant it could track response personnel and the status of helicopter evacuations, and was able to map failed infrastructure (such as roads, water and sewage lines)

2.5 July 2008 – West Coast floods

Map 2.5.1 July 2008 cut-off low: direct municipal damage costs



July 2008 – West Coast floods	
Dates	4–9 July 2008
Areas affected	West Coast District
Heaviest daily rainfall	Roode Els Berg, 6 July 2008, 200 mm
Heaviest total rainfall	Roode Els Berg, 275 mm
Social impacts	One person drowned. Closure of 16 roads as a precautionary measure by the Western Cape Transport and Public Works Department
Direct damage costs (unadjusted 2008 values)	R71.7 million
Direct damage costs (inflation adjusted 2005 values)	R57.0 million
Direct municipal damage costs (unadjusted 2008 values)	R22.3 million
Direct municipal damage costs (inflation adjusted 2005 values)	R17.7 million
URL for report	www.riskreductionafrica.org

July 2008 – West Coast floods: what happened?

The July West Coast storm was the first of the three severe weather events to strike the Western Cape in 2008, with its impact extending from the Cape Metropole to the Overberg. However, the West Coast was worst affected by the July storm, sustaining major infrastructural damage as torrential rains and high winds lashed the district. Here, the storm brought large-scale damage to farms, dams, roads and bridges. It also led to severe hardship in poor communities where homes could not withstand the flooding.

The weather system was noteworthy for its unrelenting rainfall, with daily totals ranging from 30 to 200 mm over a six-day period. In Ceres and Roode Els Berg, it will also be remembered as the wettest July since 1975. Its effects were aggravated even further by snowfalls which caused bitterly cold temperatures, especially over the Cederberg Mountains and Citrusdal.

Floods from the Olifants River resulted in widespread damage. The Olifants River also filled Clanwilliam Dam to capacity, from a storage level of 55% only two weeks before. After 1,000 cubic metres of water were measured flowing over the dam wall, 11 of the 13 sluice gates were opened to protect the dam and avert a more serious flood emergency.

Many bridges were damaged or flooded, and sections of roads were washed away. For instance, on the Citrusdal to Klawer Road only the tops of trees were visible above the rising floodwaters. The road was completely submerged. In Citrusdal and Vredendal, citrus farmers were unable to transport their produce to market, sustaining significant economic losses as a result.

A local farmer interviewed by the media, who had lived in the area all his life, could not recall a flood of such proportions before.

Did you know?

- In the Citrusdal area alone, five bridges were either destroyed or damaged and 10,000 km of gravel road needed repairs
- The Department of Transport and Public Works had to close more than 16 roads as a precautionary measure, while around 1,600 people sought disaster relief in Citrusdal, and a further 365 in Vredendal
- Joint Operation Centres (JOCs) were established in Moorreesburg, Vredendal and Citrusdal
- Disaster managers across the province depend heavily on early warning weather information from the SAWS

What do we mean by 'early warning' for severe weather events?

In recent years, the SAWS and disaster managers have developed a much more effective partnership. This has made it possible for severe weather warnings to reach local municipalities more quickly, thus enabling disaster managers to co-ordinate preparedness and response actions on the ground.

'Early warning' here, means *providing timely and effective information about an approaching storm or flood event, through defined institutions such as the SAWS and local disaster management centres*. This information enables people who are exposed to the storm or its knock-on flood effects to avoid or reduce their risk if possible, as well as to prepare to respond more effectively.

However, severe weather and flood warning systems cannot be put in place at the last minute. They are complex, scientifically and institutionally as well as socially and culturally. Not only do they depend on accurate and reliable forecast information, they also require good two-way communication between authorities and the communities in at-risk areas. This is especially the case if evacuation becomes necessary, as has happened in almost every recent severe weather event experienced in the Western Cape.

What is the South African Flash Flood Guidance (SAFFG) System?

In South Africa, flash flooding warnings used to be based on the projected impact of heavy rain over a wide area. However, these warnings were not informed by detailed information on the conditions of small river basins – where flash-flood risk is actually highest. To solve this, the SAWS and the National Disaster Management Centre began working together several years ago to develop the South African Flash Flood Guidance (SAFFG) system.

SAFFG is based on a North American flash flood warning system that was then modified for Central American countries. It pre-calculates available hydrological information for each small river basin to estimate the rainfall needed to trigger a flash flood. Then, when rain does fall over a river basin, the SAFFG software compares the actual rainfall with the pre-calculated 'flash-flood' value to identify river basins in danger of flooding. This enables the SAWS forecasters to provide more accurate flash flood warnings to disaster managers.

SAFFG is being implemented under the range of the weather radars in Gauteng, around Durban, Cape Town and Port Elizabeth, and also on the Cape South Coast. It is operated by the SAWS on a 24/7 basis, with active links to Disaster Management Centres in the relevant municipalities and provinces.

What do we mean by disaster risk management (DRM)?

Since 2003, South Africa has implemented new disaster management legislation in the form of the Disaster Management Act (No. 57 of 2002). In the Western Cape, this has resulted in the establishment of a Provincial Disaster Management Centre (PDMC) as well as five district disaster management centres and a large municipal disaster risk management centre for the City of Cape Town.

Although we are most aware of our disaster managers when a severe storm or fire occurs, their responsibilities extend well beyond contingency planning and emergency response. In fact, contemporary disaster risk management refers to:

> *integrated multisectoral… administrative, organisational and operational planning processes… to lessen the impacts of natural hazards and related environmental, technological and biological disasters*[5]

This means that disaster risk managers are increasingly required to promote developmental efforts that avoid (prevent) or limit (mitigate and prepare for) the adverse effects of hazards such as severe storms – along with their traditional role of co-ordinating emergency response efforts.

What do we mean by disaster risk reduction (DRR)?

The term *disaster risk reduction* is widely used today:

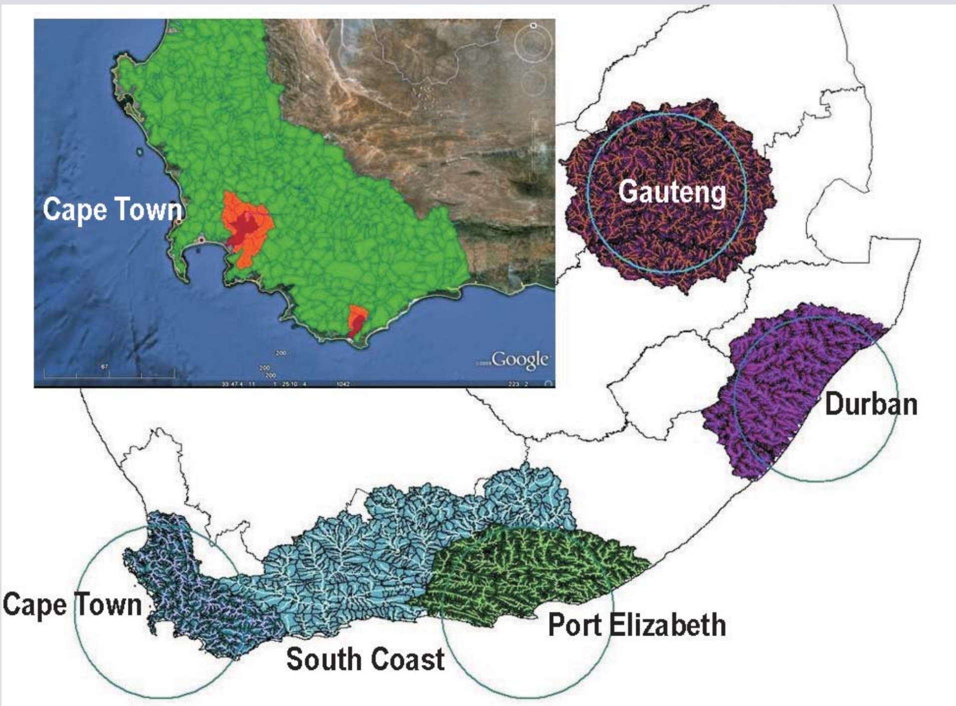
> *It refers to all elements… to minimise vulnerabilities and disaster risks throughout a society… and includes the core risk reduction principles of prevention, mitigation and preparedness*[6]

Disaster risk reduction is viewed as an important developmental strategy to minimize the adverse effects of natural and other threats. Globally, the United Nations International Strategy for Disaster Reduction (www.unisdr.org) is tasked with supporting international efforts to promote risk reduction, while the Hyogo Framework for Action (HFA) provides a global framework for advancing DRR.

How does SAFFG improve the management of flash-flood risk on a practical level?

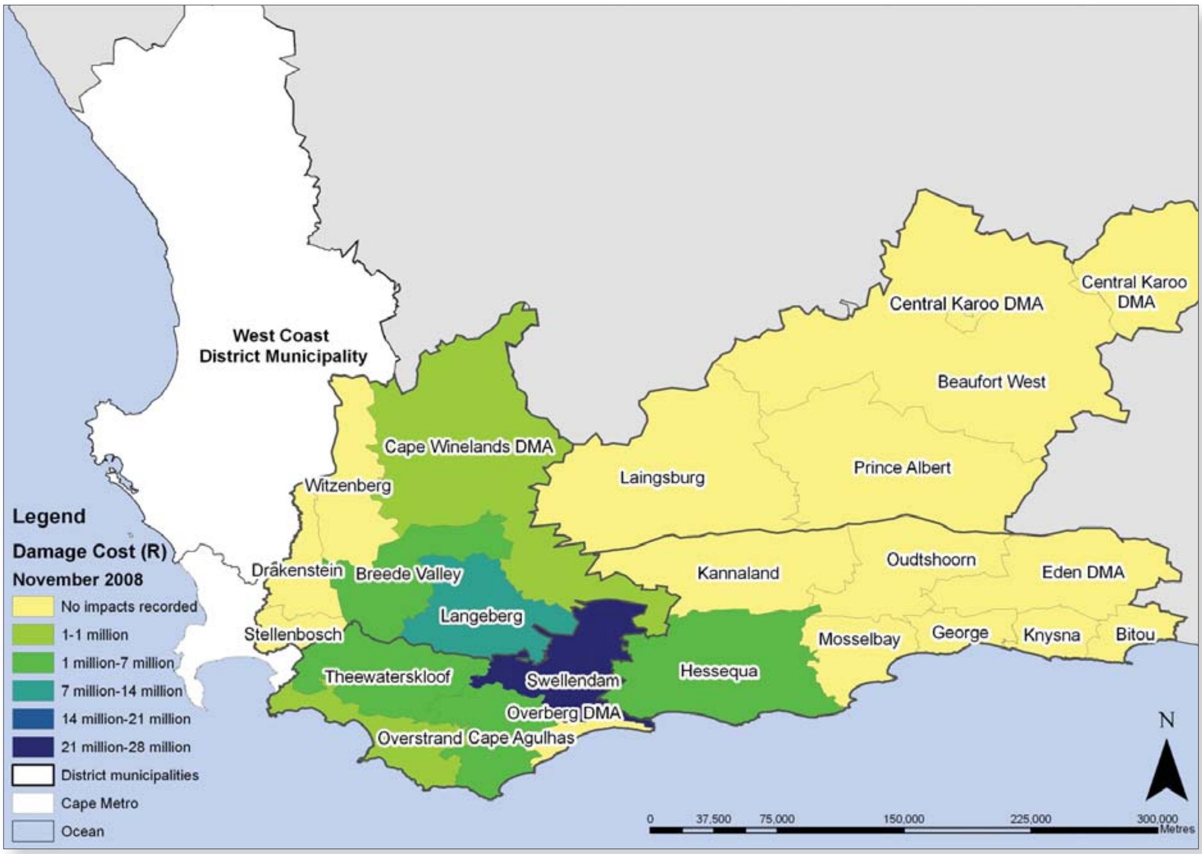
Definition Figure 6 has been enlarged in order to give an example of the size of the river basins for which individual warnings will be issued. It also illustrates a hypothetical case of flash-flood 'watches' (coloured in orange) and 'warnings' (coloured in red) for river basins in danger of flooding during a heavy rain event over the Western Cape.

Definition Figure 6 Priority SAFFG regions with basins outlined



2.6 November 2008 – Cape Winelands floods

Map 2.6.1 November 2008 cut-off low: direct municipal damage costs



November 2008 – Cape Winelands floods	
Dates	11–19 November 2008
Areas affected	Cape Winelands, Overberg and Eden Districts
Heaviest daily rainfall	Hessequa, 12 November, 118.6 mm
Heaviest total rainfall	Hessequa, 247.5 mm
Social impacts	1 death
Direct damage cost (unadjusted 2008 values)	R996.0 million
Direct damage cost (inflation adjusted 2005 values)	R791.2 million
Direct municipal damage costs (unadjusted 2008 values)	R67.5 million
Direct municipal damage costs (inflation adjusted 2005 values)	R53.6 million
URL for report	www.riskreductionafrica.org

November 2008 – Cape Winelands floods: what happened?

Almost a year after the November 2007 Southern Cape floods, another cut-off low struck. From 11–14 November 2008, the storm battered large parts of the Overberg and Cape Winelands districts, with flood impacts extending to the Hessequa municipality in the Eden District. This time, the highest rainfall was recorded in the Overberg, and the most costly damage was reported in the Cape Winelands. Rain persisted from 11–13 November 2008, with more than 150 mm falling in the town of Robertson, while in the Langeberg Mountains between 356 and 500 mm of rain were recorded.

This time, it was hoped that Hessequa would escape the worst of the floods associated with the heavy rains. However, the N2 near Heidelberg did eventually flood, due to overflows from the Vleidam. The Korentepoort Dam also reached capacity and overflowed while the Duiwenhoks and Buffelsjags dams were already in flood. The widespread flooding required close monitoring of local roads and bridges, with the protective closure of several bridges. This temporarily cut off an area known as De Draai, home to over 200 people living on 20 farms.

However, the Cape Winelands District Municipality was hardest hit by the flooding. Many farms were cut off by floodwaters, and unavoidable road closures isolated several hospitals. As ambulances could not reach these settlements and communities by road, helicopters were used to provide relief supplies, undertake evacuations and provide medical assistance.

In the Cape Winelands, one tragic death occurred in De Doorns, when a 17-year-old girl drowned trying to cross a flooded river on her way to write a Matric exam.

Did you know?

- On 10 November 2009, a year after the 2008 floods, Eden was officially declared a disaster area due to persistent drought conditions, the worst in 132 years
- In Swellendam the Breede River came down in flood, with the highest river level recorded since 1806, and in Ashton people were evacuated along the Breede River after the water level began to rise at an alarming rate (30 cm every half hour)
- Many major access routes were closed due to flooding, including those between Montagu and Ashton (R62), Ceres and Touwsrivier (R46), as well as Ladismith and Riversdale. Many low water bridges in Hessequa were also submerged, including those over the Vet, Lofu, Soetmelksfontein, Kruisrivier, Kleinkruis and Rooidraai rivers as well as the drift at the Korentepoort Dam
- The towns most seriously affected in the Breede Valley and Langeberg were Robertson, Montagu, De Doorns, Touwsriver, McGregor and Bonnievale

What is climate change?

> *Climate change refers to a change in the state of the climate that can be identified (using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to internal processes and/or external forcings. Some external influences, such as changes in solar radiation and volcanism, occur naturally and contribute to the total natural variability of the climate system. Other external changes, such as changes in the atmosphere that began with the Industrial Revolution, are the result of human activity*[7]

Although research suggests that under climate change conditions, severe weather events will become more frequent in the Western Cape,[8] it is premature to attribute the events reported in *RADAR* to climate change. Severe storm events are an integral feature of the climate in the Western Cape. They reflect the natural variability of climate processes affecting the province.

However, as the intensity of severe storms affecting the province is expected to increase under conditions of climate change, insights gained from past storms can assist planning for future adaptation. For instance, *RADAR* profiles reported multi-sectoral risk factors that have influenced socio-economic and biophysical vulnerability to recent storms and floods.

Can we attribute the damage from recent storms to climate change?

It is clear that recent storms have led to serious damage across the Western Cape, with rural and coastal areas sustaining recurrent losses. However, there are many factors that contribute to flood or storm damage that are not directly climate-related. These include the growth of towns in coastal areas or in flood plains, which immediately increases infrastructure exposure to storms and floods. The risk of damage also increases when natural flood-paths of rivers are altered and wetlands degraded in severe weather-exposed areas.

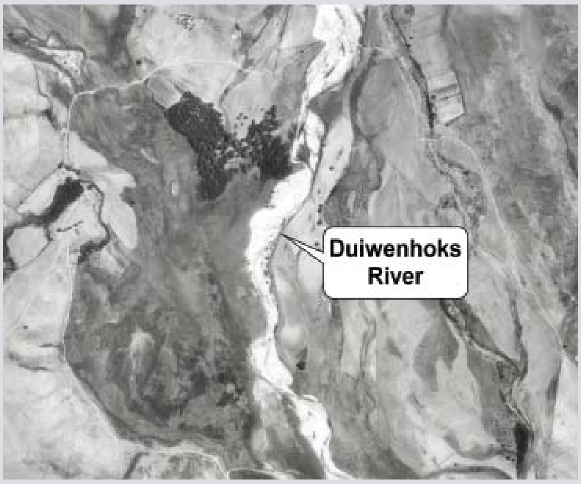
The aerial photograph sequence in Definition Figure 7 illustrates this by profiling catchment channels in the Duiwenhoks River in the Hessequa Municipality. From 2003 onwards, farmers in this area, along with residents of the town of Heidelberg itself, have repeatedly sustained damage from the flooding river.

This aerial photograph sequence traces dramatic changes in the river and flood plain from 1960 to 2006. It shows the emergence of a 'western' arm of the river from 1974, along with progressive agricultural encroachment into the natural flood plain. The 2006 image shows that the protective vegetation that would have normally enabled surface infiltration (i.e. allowed rain to soak into the ground) had virtually vanished compared to the image from five years earlier. Reportedly, until the 1960s, alien vegetation species were non-existent in this catchment.

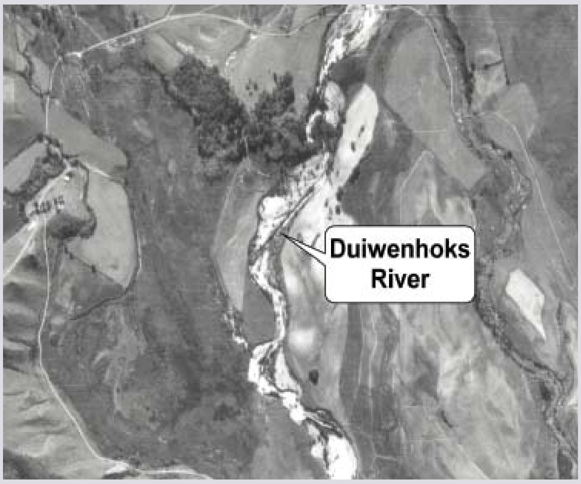
The aerial photographs also underline why flood risk management is not only necessary to reduce losses from future weather events. It is a development imperative now to protect current investments.

Definition Figure 7 These four photographs illustrate the land use changes in the Upper Duiwenhoks catchment in Hessequa between 1960 and 2006

7i The Upper Duiwenhoks River catchment 1960

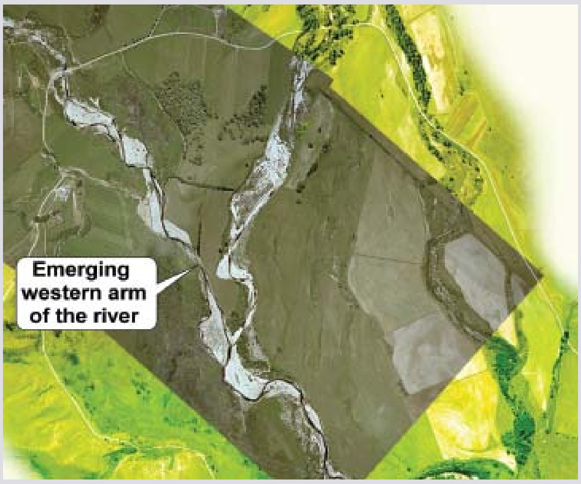


7ii The Upper Duiwenhoks River catchment 1974



7iii The Upper Duiwenhoks River catchment 2001

7iv The Upper Duiwenhoks River catchment 2006



The downstream consequences of these changes have been particularly harsh for towns like Heidelberg. Here, serious flood damage triggered by cut-off low weather systems was recorded in 2003, 2004, 2006, 2007 and 2008 (for costs incurred, see Chapter 7). This underlines the need for urgent attention to improved climate risk management *now,* as well as adaptation for *future change*.

What do we mean by adaptation to climate change?

When we speak of adaptation to climate change, we refer to:

> *Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Examples are the raising of river or coastal dykes, the substitution of more temperature-shock resistant plants for sensitive ones, etc*[9]

To sum up...

- From March 2003 to November 2008, the Western Cape experienced 11 severe weather events, the direct damage costs of which have exceeded R2.5 billion.
- The most potentially damaging weather systems have been cut-off lows. However, the severity of damage associated with these events was also affected by other conditions – such as the level of soil saturation from preceding rainfall.
- The cut-off lows have had impacts on different geographic scales, reflecting their respective paths, with many affecting more than one municipality or district.
- This means that we often name these weather events incorrectly. For instance, the March 2003 cut-off low is popularly known as the 'Montagu floods'. However, Hessequa and George also sustained serious losses as the system tracked across the Southern Cape.
- The recurrent storms are "transboundary events" that trigger floods with serious knock-on consequences downstream. However, substantial damage to schools and poorly-constructed homes has also occurred, due to the sheer volume of rain beating against roofs, walls and windows.
- In many areas, the same roads and public infrastructure (such as sewage treatment plants) fail repeatedly, requiring recurrent repairs. This diverts overstretched budgets to patching up and repairing damage, away from development priorities.
- Since 2003, municipal and provincial capacity to manage the effects of severe storms has improved vastly, especially in areas where these occur frequently. At the same time, the province's risk profile has become more complex. This requires more proactive measures to manage climate risk as a development priority, rather than depending on emergency response capacity when a storm approaches.

Chapter 3

Municipalities bear the brunt

Chapter 2 summarised the larger weather and flood events caused by cut-off low systems that have affected the Western Cape in recent years. However, other events occurred that were also costly. These storms generally led to highly localised and less spectacular damage, often limited to one city or municipality.

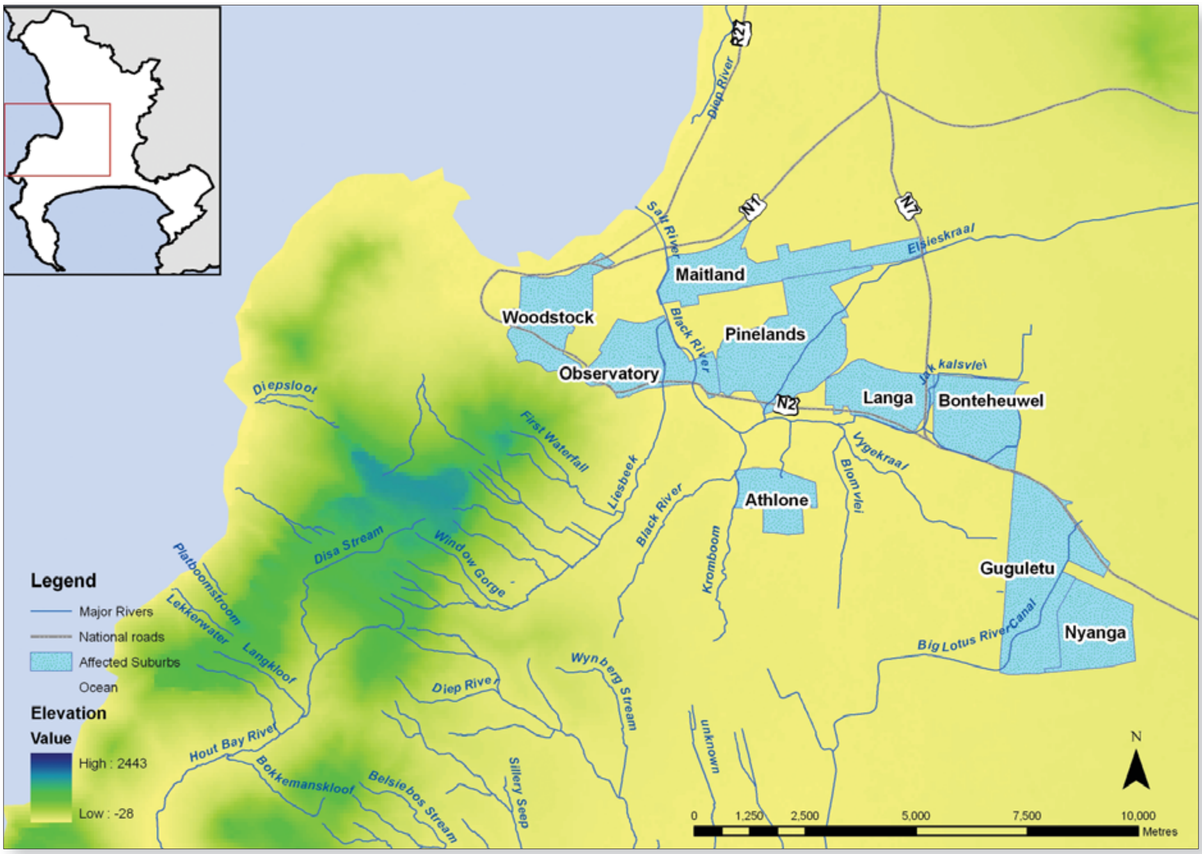
This chapter reviews the impact of five severe storms, four of which resulted in local damage. They- include two frontal systems that affected the City of Cape Town in 2004 and 2008, as well as cut-off low weather systems that struck the Southern Cape and the Cape Agulhas Municipality in 2004 and 2005 respectively. For the December 2004 cut-off low, in-depth research was limited to Hessequa. The fourth example was a damaging hailstorm that occurred east of Haarlem during 2006.

This overview highlights the potentially destructive nature of these localised weather events, given their associated intense rainfall, driving winds, hail, flash floods and storm surges. In Bredasdorp and Heidelberg, local canals were transformed into flash-flooding torrents; and in Cape Town in 2004, intense rainfall over the Salt River catchment area led to city-wide disruptions and damage. The adverse developmental consequences of severe storms were particularly apparent in the example of Haarlem, where the costs extended beyond a lost harvest to affecting the well-being of the local economy.

This image shows severe flooding in Ashton following the March 2003 'Montagu floods'. This event was not only reflected in serious damage to public infrastructure and agriculture. It also disrupted local livelihoods due to damage sustained by the local canning factories.

3.1 August 2004 – Cape Town severe storm

Map 3.1.1 August 2004 cold front: direct municipal damage costs



August 2004 – Cape Town severe storm	
Dates	4–9 August 2004
Areas affected	City of Cape Town
Heaviest daily rainfall	Athlone, 5 August, 106 mm
Heaviest total rainfall	169.7 mm, Cape Town weather office
Social impacts	20,000 informal residents affected
Relief costs	R2.2 million
Reported insurance claims (unadjusted 2004 values)	R4.3 million (in insurance and government staff costs*
Reported direct relief costs (unadjusted 2004 values)	R2.2 million (in relief costs)*
Reported insurance claims (inflation adjusted 2005 values)	R2.4 million*
Reported direct relief costs (inflation adjusted 2005 values)	R4.5 million*
URL for report	www.riskreductionafrica.org

** In the case of the City of Cape Town, municipal damage costs were difficult to consolidate across City departments. Costs reported here refer to emergency relief, or to estimates provided by the insurance industry.*

August 2004 – Cape Town severe storm: what happened?

On Thursday 5 August 2004, an intense rainstorm struck the City of Cape Town during peak morning traffic. The rainfall was particularly severe in Pinelands and Athlone, exceeding the '100-year return' period for a 2- to 3-hour storm. Then, from 7 to 8 August, a second frontal system hit the city. Together, these storms led to widespread and serious flooding in both formal suburbs and informal settlements. Over 4,500 informal dwellings were flooded.

On 5 August, 2 to 3 hours of heavy rain fell over Athlone (67 mm) and Pinelands (62 mm). The intensity of rain also caused the Jakkalsvlei and Black Rivers – the main tributaries of the Salt River catchment area – to burst their banks. This led to back-flooding in Bonteheuwel and Pinelands, where many homes and streets were flooded.

A sporting facility and related car park in Observatory were also flooded, due to reverse flow up the Liesbeek River from Salt River. Factories in Beach Road in Maitland were inundated, and major disruptions occurred during peak afternoon traffic due to flooding of the N1 under the Koeberg Road Bridge.

The first storm affected informal settlements only slightly, although 100 homes did flood in Gxa-Gxa Gugulethu. This was because they were located in a stormwater pond which filled with water. However, many of Cape Town's informal settlements were flooded by the second storm. This is interesting, because the storm itself was not considered significant from a hydrological point of view. The worst-affected settlements were located in Kraaifontein, Langa, Gugulethu/Nyanga, Khayelitsha and Somerset West. In these areas, approximately 20,000 people needed assistance from social services and relief organisations.

Did you know?

- The City of Cape Town stormwater management system includes 1,200 km of rivers and streams, 5,500 km of underground pipes and culverts, 650 detention and retention ponds and 150,000 gullies and intakes
- Over a hundred trains were delayed and 13 trains cancelled during these two storms
- Six organisations and the government Housing Department provided emergency relief at a cost of over R2.2 million
- The Western Cape is exposed to more than four different types of flood risk

What are the main types of endangering flood in the Western Cape?

Flooding does not automatically constitute a threat or risk. Naturally-occurring floods (just like fire regimes for *fynbos*) may be highly beneficial to our natural environment. They are essential for protecting the health of our wetlands and rivers, as well as for preserving the biodiversity of these systems. However, floods can also be extremely dangerous, and can lead to costly damage and loss of life.

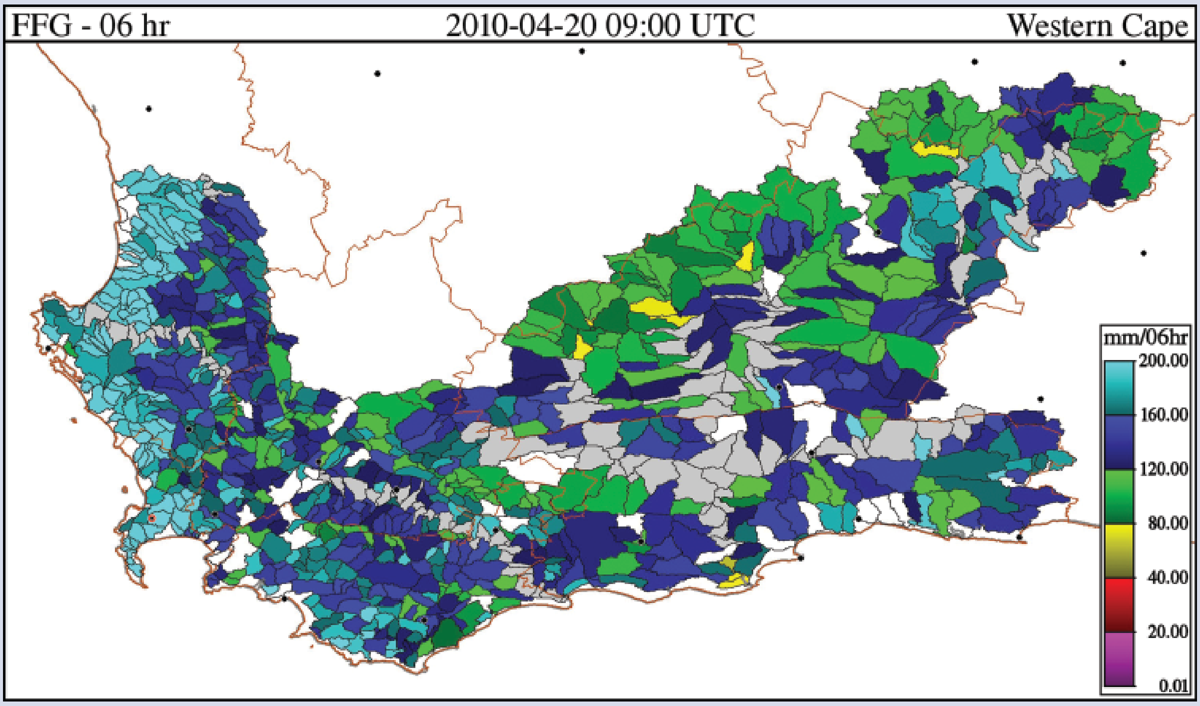
In the Western Cape, development next to rivers and coastal areas has compromised many of nature's protective flood attenuation services (for example the natural 'soaking up' of flood waters by wetlands). It has also directly exposed property to the risk of flooding. In addition, the surfaces of many catchments have been 'hardened' by development, while the growth of informal settlements in fragile ecological areas has both degraded these systems and placed thousands of people at risk.

RADAR illustrates the main types of endangering flood experienced in the Western Cape: flash flooding, river floods, rising floods and storm surges.

What are flash floods?

Flash floods are quick response flood events that cause sudden flooding in small river basins. Usually, flooding occurs within six hours after a heavy rain event. Flash-flooding can also occur on hardened or degraded surfaces that are dry most of the time and may not even look like rivers. These may include tiny streams and dry river beds, as well as cleared pathways and areas around electricity and telecommunication servitudes.

Definition Figure 8 A typical flash flood guidance map for South Africa



This map indicates the volume of rain needed in each specific basin for flooding to occur (ie the number of millimeters of rain over six hours.)

Urban flash-flooding includes the flooding of streets, underpasses, low-lying areas or storm drains in urban areas. Run-off from highly localised and intense storm events can rapidly transform normally dry and harmless surfaces into life-threatening, raging torrents. Clear examples of flash floods include the Cape Town severe storm (August 2004) and Bredasdorp floods (April 2005) described in this chapter. These illustrate the intense and highly damaging nature of flash-floods, particularly as there is usually little or no advance warning.

What are river floods?

River floods occur when prolonged (i.e. over several days) heavy rain in an upper catchment increases water levels in river channels, leading to *flood waves*. Rising water levels eventually overflow a river's banks, inundating adjacent areas before flowing downstream.

River floods are serious *transboundary* processes, in which the consequences of poorly-managed flood risk in an upper catchment results in serious flood losses downstream. They can also be exacerbated by the sudden release of water from dams when sluices are opened to prevent them overtopping. Clear examples of damaging river floods are illustrated in Chapter 2 by the West Coast and Cape Winelands floods of 2008 (see pgs 24 and 28).

What are 'rising floods' or 'pooling'?

'Rising floods' or 'pooling' occur when there is an accumulation of water in an area that leads to general flooding, but without any significant river flow. In the Western Cape, rising floods occur most often in informal settlements located close to wetlands, or in high-water-table areas where there is limited or blocked drainage. While the term 'rising floods' is not typically used in conventional flood definitions, it does reflect the reality in many of the province's informal settlements. In low-lying areas such as Masiphumelele and Philippi in Cape Town, or Power Town in the Southern Cape, seasonal rising floods are a source of great hardship during the Cape's winter months. Clear examples of rising floods in *RADAR* can be found in the reports on Cape Town's severe storms of 2004 and 2008 and the Southern Cape compound disaster of 2006 (see pgs 16, 34 and 46).

What are storm surges and coastal floods?

A storm surge is the pushing of water to abnormally high levels against a coastline, usually caused by a combination of extreme low pressure and strong winds pushing water into a narrowing feature, such as a bay or estuary. However, coastal flooding is not only caused by endangering storm surges that drive run-up onto the land. It is also a result of run-off from rivers and stormwater discharge that flows down to the sea as the result of heavy rainfall onshore. This makes the management of coastal flooding extremely difficult, especially in estuarine areas such as Sedgefield, as illustrated by the South Coast floods of 2006 and 2007 (see pgs 16 and 22). Powerful storm surges increase the risk of damaged coastal infrastructure, graphically represented by the Cape Town severe storm of 2008 in this and the following chapter (see p46).

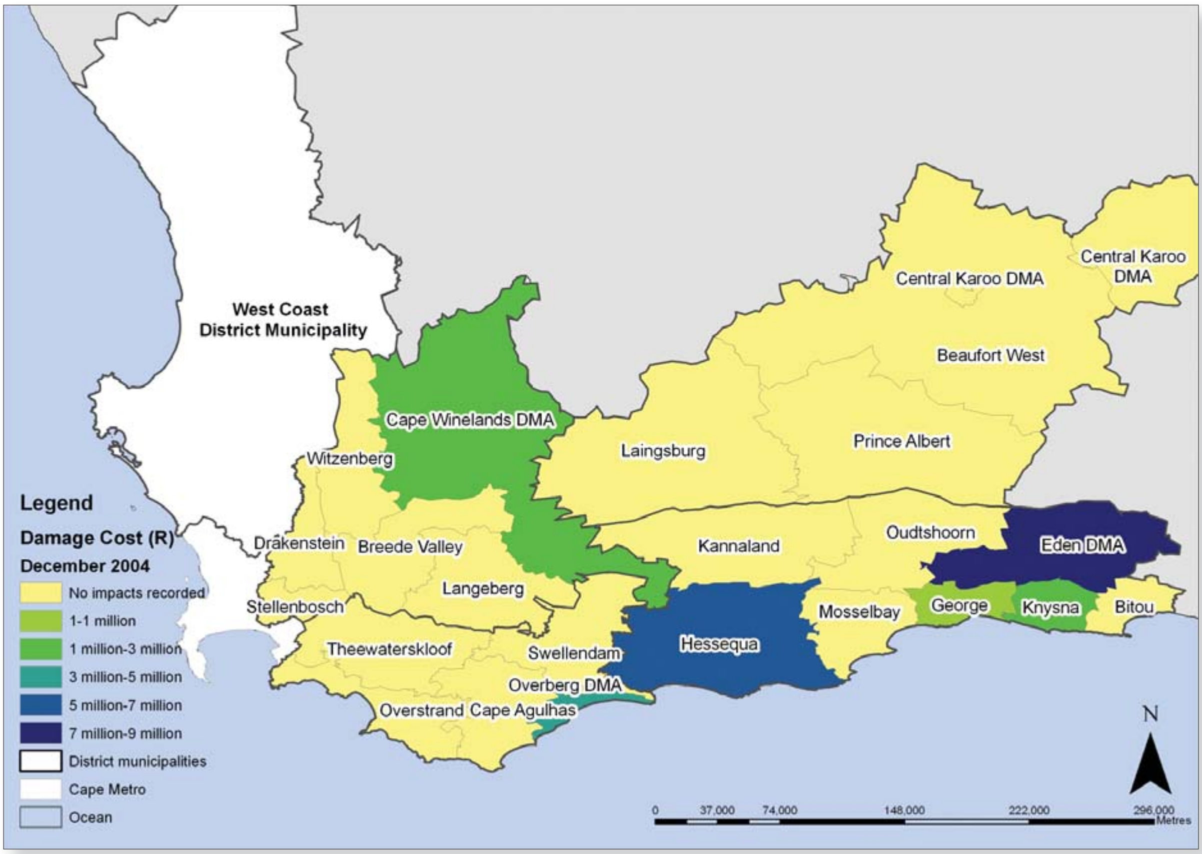
In the Western Cape, severe weather events can lead to two or more of these flood types at the same time. For instance, the 2004 December cut-off low generated severe riverine flooding of the Duiwenhoks River, as well as flash flooding of the canalised Doorn River that runs through the Hessequa town of Heidelberg (see p38).

Definition Figure 9 Storm surge in Kalk Bay at daybreak on 1 September 2008

Waves of 12-15 metres associated with severe storm conditions as observed in Kalk Bay.

3.2 December 2004 – December cut-off low

Map 3.2.1 December 2004 cut-off low: direct municipal damage costs



December 2004 – December cut-off low	
Dates	21–23 December 2004
Areas affected	Cape Winelands, Overberg and Eden Districts
Heaviest daily rainfall	Knysna, 22 December, 199.2 mm
Total heaviest rainfall	Knysna, 21–23 December, 218.8 mm
Social impacts	3,636 homes and 40 businesses were rain or flood affected, including 2,703 informal or low-income homes
Direct damage cost (unadjusted 2004 values)	R54.9 million
Direct damage cost (inflation adjusted 2005 values)	R57.9 million
Direct municipal damage costs (unadjusted 2004 values)	R21.0 million
Direct municipal damage costs (inflation adjusted 2005 values)	R22.1 million
URL for report	www.riskreductionafrica.org

December 2004 – Cut-off low: what happened?

On 21 December 2004, a cut-off low hit the Southern Cape again, with heavy rain in Heidelberg (118.5 mm). The next day, 185 mm fell in Robertson and 199.2 mm in Knysna. Notably, Robertson actually recorded 6.59 times more rain over a three-day period than on average for the entire month of December. Similarly, Knysna recorded a total rainfall of 218 mm for this three-day storm.

One of the most notable aspects of the December 2004 cut-off low was the destructive nature of the flash-floods that followed, although this kind of flood is not unusual in the Southern Cape. Local residents are well aware that extremely heavy rainfall over the area's steep catchments often results in high run-off, short-delay flash floods. These are known to gouge out riverbanks, destroy any infrastructure in their path, rip up large trees, inundate flood plains and carry an enormous amount of sediment and debris downriver.

This was certainly the case during the December cut-off low. The town of Heidelberg was especially flood-affected:

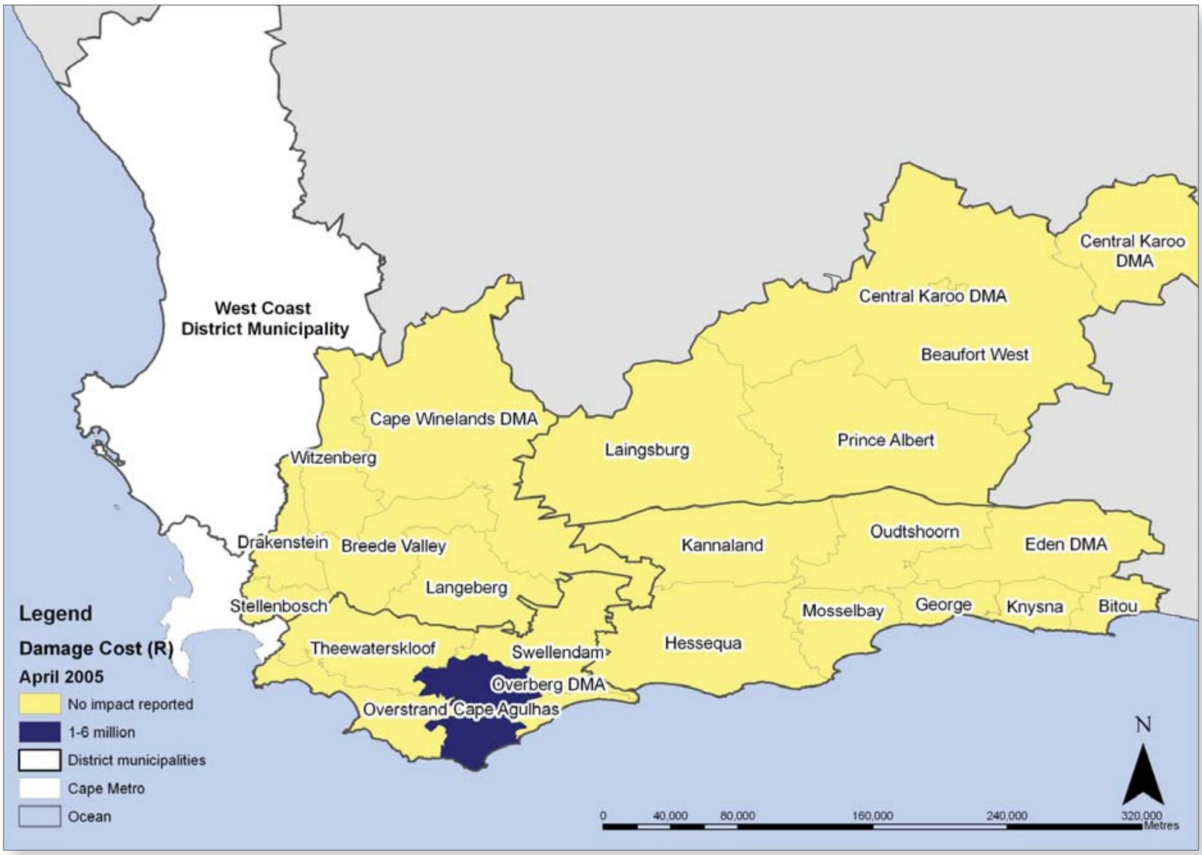
> *"The damage in Heidelberg was partly due to the town's location. It lies next to the larger Duiwenhoks River, with a tributary, the Doorn River, canalised through the middle of the town. The two rivers come together on the outskirts of Heidelberg.*
>
> *In the December 2004 floods, the tiny stream that normally represents the Doorn River was transformed into a raging torrent. It burst its banks and flooded adjacent properties, ripping up cement walkways and tearing out chunks of road. The Duiwenhoks River also burst its banks, and together, these two rivers inundated a large part of the town. This caused extensive damage to both property and infrastructure.*
>
> *The worst damage was caused by the complete flooding of the sewage works. This led to raw sewage being discharged into the Duiwenhoks River. The same facility had also flooded in the March 2003 cut-off low event, and had just been repaired."*[10]

Did you know?

- The Heidelberg sewage treatment plant was flood-damaged in March 2003, December 2004 and again in August 2006
- Suurbraak residents who weather-proofed their homes after the 2003 Montagu flood were not as badly affected by the December 2004 cut-off low
- When a flood disaster occurs, this means that the flood risk has been 'realised' and has resulted in losses of some kind

3.3 April 2005 – Bredasdorp floods

Map 3.3.1 April 2005 cut-off low: direct municipal damage costs



April 2005 – Bredasdorp floods	
Dates	10–12 April 2005
Areas affected	Cape Agulhas Municipality
Heaviest daily rainfall	Bredasdorp 177 mm
Heaviest total rainfall	Bredasdorp, 10–12 April, 228 mm
Social impacts	Low-cost housing residents in Kleinbegin flooded as water flowed through houses to reach river
Direct damage cost (unadjusted 2005 values)	R8.9 million
Direct damage cost (inflation adjusted 2005 values)	R8.9 million
Direct municipal damage costs (unadjusted 2005 values)	R5.5 million
Direct municipal damage costs (inflation adjusted 2005 values)	R5.5 million
URL for report	www.riskreductionafrica.org

April 2005 – Bredasdorp floods: What happened?

From 10–12 April 2005, less than four months after the December 2004 Southern Cape floods, another strong cut-off low struck. This time it was the Cape Agulhas Municipality that bore the brunt. Bredasdorp, situated at the foot of the Heuningsberg Mountains, was seriously flood-affected by the 228 mm of rain that fell over the three days.

The severity of the flood damage was exacerbated by a 'sloot' (or canal) that had been designed to drain run-off quickly. This canal ran through the town, from the Drinkwater Kloof above Bredasdorp into the Droë River located below the town. It was constructed *after* homes had already been built. This meant that it was designed with kinks and bends to accommodate existing properties. During this storm, the 'sloot' flooded houses and roads due to the high volume of high-speed run-off (in other words, water flowing in a straight line regardless of the 'sloot's' bends and kinks). This caused serious damage to properties in the water's path.

As is the case in many towns across the Western Cape, Bredasdorp's municipal stormwater capacity was inadequate for such a storm. This was due to irregular maintenance of both the stormwater system and the sloot, reflected in debris-loading due to litter, soil-erosion and alien plants. For instance, litter, rubble and other dumped objects blocked stormwater drains and streams, worsening the impact of the floods.

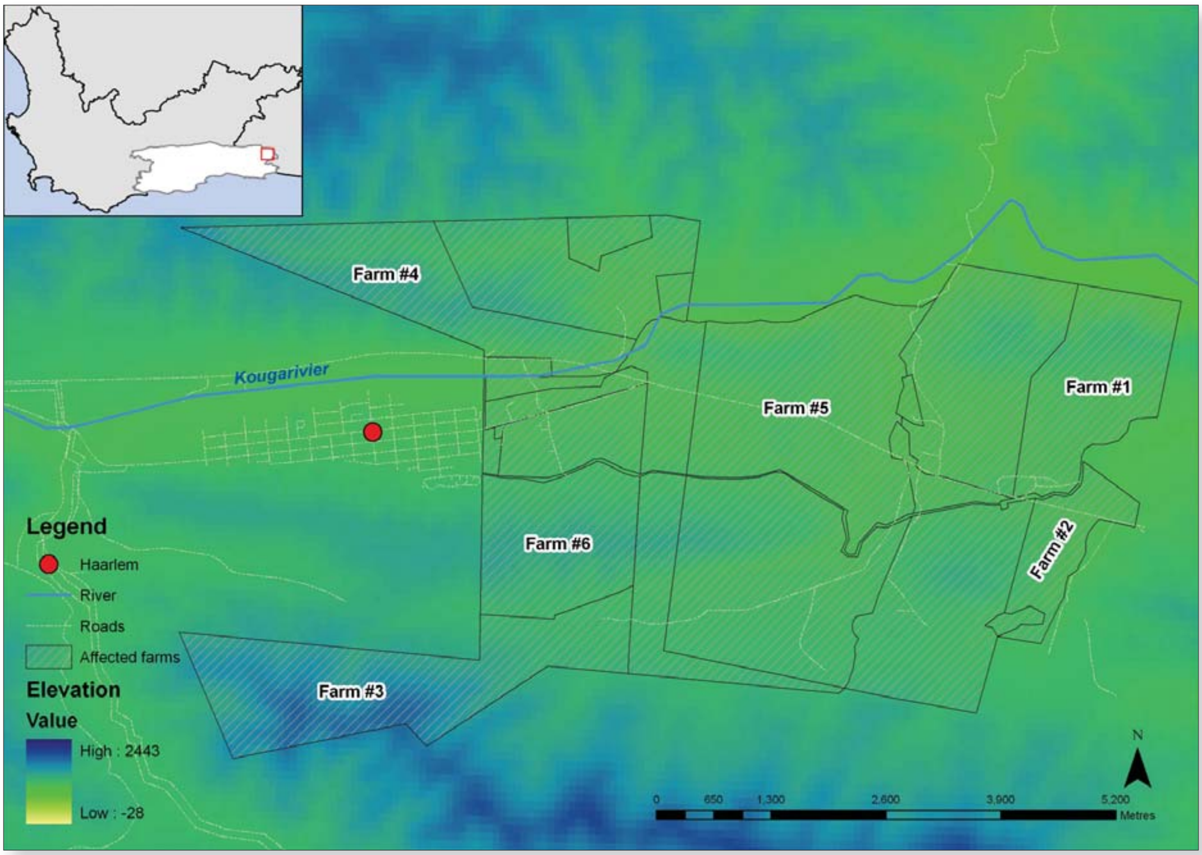
Another reported flood-risk driver was debris-loading from soil erosion because the exposure of large tracts of land for wheat planting, along with vegetative debris-loading associated with alien vegetation clearance. Cleared alien plants left to decompose near rivers were washed into watercourses and then swept downstream, where they obstructed culverts, channels and bridges.

Did you also know?

- The Overberg District Municipality is severely fire-prone, with 875 wildfires reported from April 2002 to March 2003
- After the 2005 flood, Bredasdorp introduced a protocol for clearing stormwater channels after weather warnings, as well as measures for regular stormwater maintenance
- It is not **ever** safe to wade across a flash-flooding river or canal if the water is more than ankle height. The speed of the water can knock you off your feet and sweep you away.

3.4 November 2006 – Haarlem hailstorm

Map 3.4.1 November 2006 hailstorm: six of the seven farms affected



November 2006 – Haarlem hailstorm	
Date	20 November 2006
Areas affected	Haarlem*
Social impacts	Loss of livelihood for small traders
Direct damage cost (unadjusted 2006 values)	R9.2 million
Direct damage cost (inflation adjusted 2005 values)	R8.6 million
Direct municipal damage costs (unadjusted 2006 values)	R9.2 million
Direct municipal damage costs (inflation adjusted 2005 values)	R8.6 million
URL for report	www.riskreductionafrica.org

**The area specifically affected by the hailstorm was located east of Haarlem, near Uniondale in the Eden DMA*

November 2006 – Haarlem hailstorm: what happened?

At approximately 3.30pm on Monday 20 November 2006, a devastating hailstorm hit an area in Langkloof east of Haarlem, near Uniondale. Seven farms were badly affected – irrigation systems and 389 hectares of fruit trees were destroyed. It also resulted in injuries to farm workers.

The hailstorm had a social and economic impact that went well beyond the damage to the fruit trees. This is not only because Haarlem depends mainly on agriculture and farming activities for its local economy, but also because it is the second-poorest area in the Western Cape. The storm disrupted the livelihood of many families and individuals, including 624 breadwinners, 194 permanent farm workers, 230 temporary workers, and 35 small traders. The social costs of higher unemployment were also reflected in increased criminal activity.

Following the hailstorm, the Eden District Municipality (EDM), in conjunction with a Task Team that representing the local residents and farmers, initiated and funded eight recovery projects costing almost R9.2 million. These encompassed social relief, river bank clean up, stormwater drainage and repairs to the Haarlem Dam. The funds were also used to develop a training manual for farm workers on how to treat hail-damaged trees. These measures not only led to improved treatment for the trees, but also strengthened the skills of local farm workers affected by the storm.

Despite these efforts, on 24 July 2007 the EDM declared the hailstorm a local disaster, and requested additional support from the Provincial Disaster Management Centre.

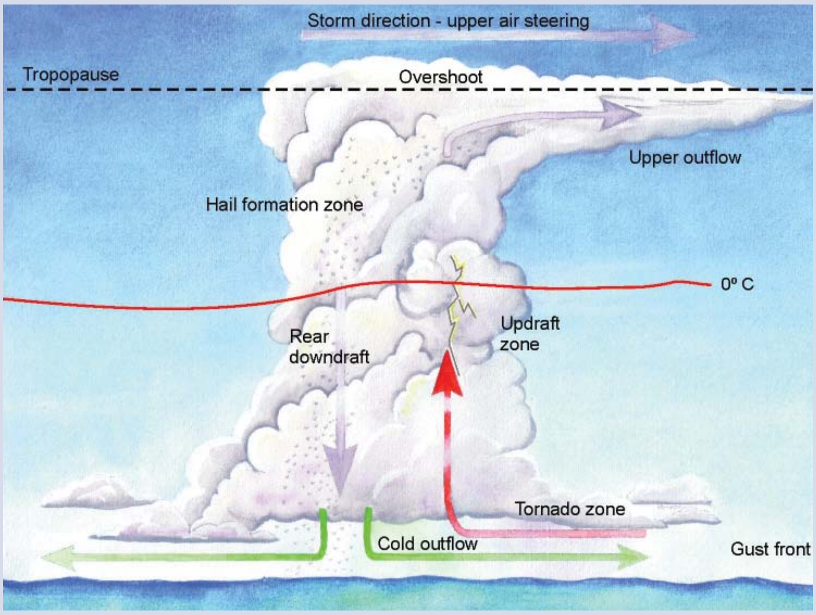
Did you know?

- Fruit trees cannot be insured against hail damage as its impact is difficult to assess accurately
- The same farmers hit by the Haarlem hailstorm were also affected by the August 2006 and November 2007 floods
- The comprehensive hailstorm recovery package received by farmers meant they could continue to employ their farm workers, despite the 2007 floods and economic recession
- Hailstorms are usually generated by convective storms, which are more likely to occur inland and during the hot summer months

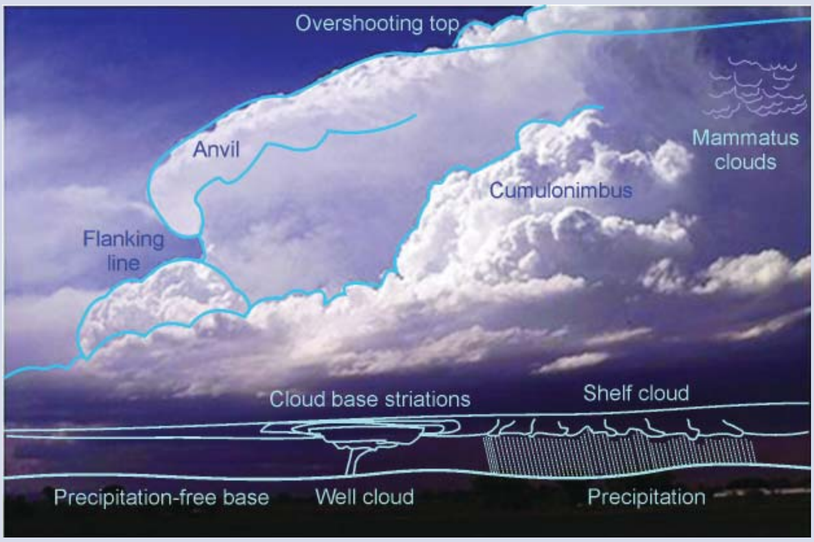
What is a convective storm?

Convection is the upward movement or transport of air. This happens when the earth's surface and lower atmosphere warm up, causing surface air to rise. As the air rises, it cools down, sometimes leading to towering cumulonimbus clouds that bring thunderstorms. Convective storms occur most often in the hottest months, when the surface temperatures are high. They are more likely to occur inland rather than in coastal areas, due to the ocean's cooling effects.

Definition Figure 10 A large thunderstorm cloud illustrating cloud formation and features



Definition Figure 11 A photograph of a thunderstorm, also known as a "convection storm", illustrating cloud features



Air movement within a convection storm can also lead to other severe weather phenomena, such as lightning, tornadoes, thunderstorm downbursts and hailstorms.

How do convection thunderstorms form?

Definition Figure 10 illustrates how convection thunderstorms form. Air is sucked up the front, rising to a height at which the air temperature is below zero degrees. The air then cools, and condenses, releasing a lot of energy. It becomes dense, and then falls back towards the ground at the rear of the system as rain and hail.

What do we mean by the term 'severe thunderstorm'?

Severe thunderstorms do not occur often in the Western Cape because our climate is not suited to thunderstorm formation and intensification. However, meteorologically thunderstorms are classified as 'severe' if they result in the following conditions:

1. Downdraught winds of more than 90 km/hr can result in severe 'microbursts'. For instance, the storm popularly known as the 'Manenberg tornado' was more likely to have been a microburst, as illustrated and explained in the caption for Definition Figure 12.
2. Hail that is 2 cm in diameter or larger.
3. Excessive lightning.
4. One or more tornadoes.

Definition Figure 12 Damage sustained by homes in Manenberg, Cape Town following the 'Manenberg tornado' of August 1999

This picture illustrates the destructive force of a 'microburst' caused by downdraught winds, or air that falls out of a thunderstorm system. This air starts from the top of the system where it is very cold and dense. It then falls, picking up speed, and subsequently explodes out of the rear of the storm. This wind is called a 'microburst', and can cause severe damage.

What does the term 'superstorm' mean?

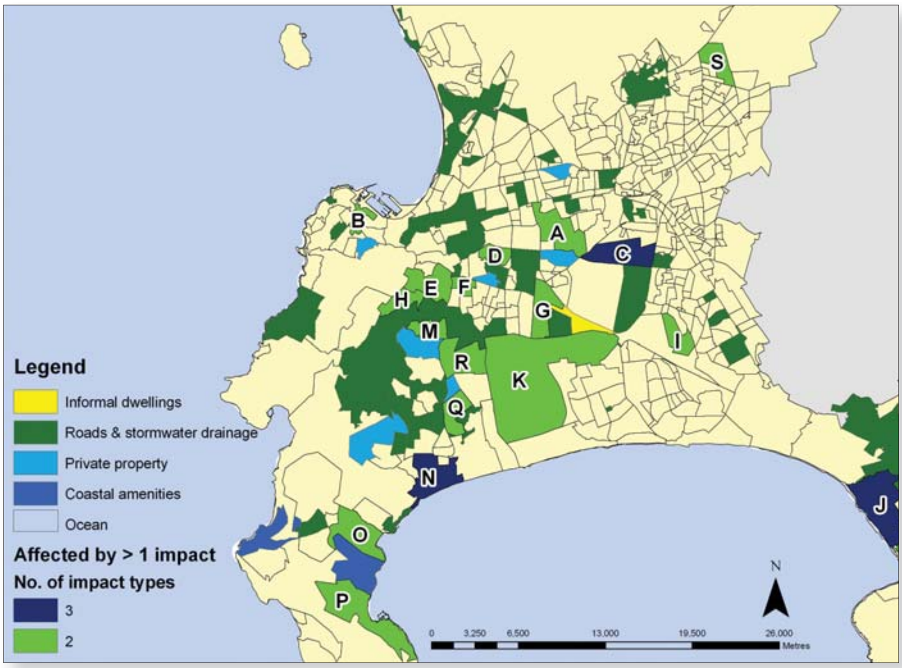
The expression 'superstorm' is not a scientific term. It has a more sensationalist media interpretation rather than a specific meteorological meaning. From a meteorological perspective, it is more correct to use the term 'severe thunderstorm' or 'severe storm'.

In August 2008, the City of Cape Town was affected by a severe frontal system that was popularly referred to as a 'superstorm'. The storm led to widespread damage, making landfall just over a month after heavy rainfalls had triggered flooding in informal settlements across the city.

3.5 August 2008 – Cape Town severe storm

Map 3.5.1 August 2008 severe storm: areas affected

Ref.	Suburb	Impact Type			
		Inf	R/ SW	PP	C
A	Elsies River		√	√	
B	CBD		√	√	
C	Belhar	√	√	√	
D	Langa		√	√	
E	Rondebosch		√	√	
F	Athlone		√	√	
G	Guguletu	√	√		
H	Newlands		√	√	
I	Mfuleni	√		√	
J	Strand	√	√		√
K	Philippi	√	√		
L	Gordons Bay		√		√
M	Kenilworth		√	√	
N	Muizenberg		√	√	√
O	Fish Hoek	√			√
P	Simons Town		√		√
Q	Grassy Park	√	√		
R	Ottery		√	√	
S	Kraaifontein		√	√	



Inf = Informal dwellings, R/SW = Roads & stormwater, PP = Private property, C = Coastal amenities

August 2008 – Cape Town severe storm	
Dates	30–31 August 2008
Areas affected	City of Cape Town
Heaviest daily rainfall	Cape Town Weather Office, 31.6 mm
Heaviest total rainfall	Cape Town Weather Office, 31.6 mm
Social impacts	14 informal settlements affected by floods and strong winds Private/public infrastructure damaged by storm surge and associated flooding Disrupted electricity supply because of falling trees and branches due to gale force winds and heavy rain
CoCT direct damage costs to coastal amenities (unadjusted 2008 values)*	R4.9million
CoCT direct damage costs to coastal amenities (inflation adjusted 2005 values)*	R3.9million
Report URL	www.riskreductionafrica.org

** In this event the damage costs were difficult to consolidate across CoCT departments. Costs reported here are for coastal amenities provided by CoCT Coastal Coordination and Coastal Zone Management.*

August 2008 – The Cape Town severe storm: what happened?

The Cape Town severe storm of 2008 was the most intense system to hit the Western Cape since September 2001. This serious weather event brought heavy rain combined with thunder and lightning, as well as low temperatures and mountain snows. Winds of between 35 and 82 km/hr drove seven-metre-high storm surges in coastal areas such as Kalk Bay and Bakoven.

Fortunately, the SAWS and the National Search and Rescue Institute (NSRI) detected the powerful frontal system early and issued extreme weather warnings on 29 August 2008. These were widely disseminated through various media including newspapers (with press releases from Disaster Risk Management), radio stations and by SMS.

Although there was localised flooding due to blocked drains in many formal suburbs, storm damage was far worse for properties and businesses located along the coast. These suburbs were flooded and sustained structural damage from the pounding waves generated by the storm surges and heavy rainfall. Gale-force winds and accompanying rain wreaked havoc with electricity supply across the city, as falling trees and branches damaged overhead power lines.

Fourteen informal settlements were affected, in Mfuleni, Philippi, Gugulethu, Belhar, Grassy Park, Old Cross Roads, Fish Hoek, Strand and Klipfontein.

This storm was one more weather 'knock' in a winter that would be remembered for its unrelenting demands on humanitarian assistance. Between May and June this included the provision of emergency aid to 22,000 displaced foreign nationals, followed in July by similar demands for flood relief in 70 informal settlements.

Did you know?

- Disaster Risk Management has identified 51 informal settlements as being at high flood risk, mainly South-east of the Metro
- The informal settlements in Cape Town with the highest risk of flooding are Kosovo, Bongani TR Section, Barney Molowana Corner, Masiphumelele and CT Section Khayelitsha
- Over 180 mm of rain fell in Cape Town during July 2008. This is equal to 34% of Cape Town's average annual rainfall
- Fourteen weather-related traffic accidents were reported during the August storm

To sum up...

- Although the damage costs of localised storms may not appear as great as those of large weather events, highly localised storms are also important because to their extremely disruptive effects on local economies.
- The chance of severe weather-related damage increases when natural flood attenuation systems are altered through agricultural or urban development. It also increases when there is low investment in municipal maintenance and in upgrading stormwater systems.
- In rural areas, flash-flood risk is greater when intense wildfires precede the onset of the winter rains, resulting in more surface run-off. This is particularly the case when the fires have involved large tracts of alien vegetation, which burns more intensely than indigenous vegetation.
- Sediment and vegetative debris-loading are important contributing risk factors for failure of rural bridges and culverts. This risk can be reduced by clearing debris from water courses prior to the rainy season, or when a severe-weather warning is issued.
- Mapping and consolidating information on damage after a severe storm or flood is not just a cost-counting exercise. It assists with integrated and spatial development planning by highlighting vulnerable and exposed areas, as well as in contingency planning for future storms.
- In the Western Cape, flash flooding is a particularly dangerous type of flood risk because of our small river basins, and the fact that dry surfaces can quickly transform into raging torrents. The SAFFG System helps to protect lives and property in flash-flood exposed areas.

A complex urban disaster: The social violence of 2008

Chapters 2 and 3 focused mainly on severe weather events that have affected the Western Cape in recent years. Chapter 4 profiles another risk that emerged unexpectedly – the widespread attacks against foreign nationals in May 2008.

This escalated into one of the most complex emergencies ever seen in South Africa. Across the country, non-nationals were attacked and their properties burned and looted. Over 60 people were killed, and between 80,000 and 200,000 people were displaced and sought refuge.

Although other areas of the Western Cape were also affected, this chapter focuses specifically on the eruption of xenophobic violence that occurred in the City of Cape Town. It shows how this was a different type of emergency, which placed new demands on both governmental and non-governmental actors. This was due not only to the scale of the humanitarian need, but also to the sheer complexity of the response required. It was also necessary despite concerted and dedicated efforts by government and civil society to alleviate the fear, hardship and uncertainty that affected so many non-South Africans.

Chapter 4 is not intended to be an exhaustive or detailed account of the event. Rather, it profiles the inherent difficulties in managing complex social threats - such as xenophobic violence - which can spark a diffuse, difficult and rapidly-changing emergency, and which require an unprecedented response.

The complex nature of the 2008 social violence emergency led to some displaced foreign nationals seeking assistance up to two years after May 2008.

4.1 May 2008 – What sparked the violence in the Western Cape?

In early May 2008, attacks against (mainly) foreign nationals living in Alexandra in Johannesburg sparked violence against foreigners in townships and informal settlements across the country. The Western Cape was the last province to experience violence, with most of the attacks and displacement occurring in the City of Cape Town (CoCT). However, displacement occurred in other parts of the province, as shown in Table 4.1.1.

Table 4.1.1 People displaced in the Western Cape (27 May 2008)

Municipality	Number displaced
City of Cape Town	20, 418
Drakenstein	730
Saldhana Bay	590
Overstrand	226
George	150
Knysna	200
Theewaterskloof	100
Total	**22, 414**

Violence broke out in the CoCT on the evening of Thursday 22 May, when informal homes were destroyed and looted and one person was shot and killed in Du Noon, near Table View. Attacks quickly spread to other parts of the city, including the Cape Flats, the Southern Suburbs and the city centre. The distribution and timing of xenophobic attacks in the CoCT is illustrated by the blue and green circles on Map 4.5.1 (see p55).

4.2 How many people sought refuge? Where did they go?

Thousands of people fled their homes as news of the attacks spread. At the height of the violence, it is estimated that 20,000 to 22,000 people were displaced in the CoCT[11]. It is also thought that as many as 30,000 people may have left the city in the first few days after the violence began.[12]

At first, people sought refuge at police stations, churches, mosques and other religious and private facilities. The CoCT also made its halls and community facilities available. By the weekend (23–24 May) there were already over 20,000 displaced people at more than 100 sites throughout the Metro.

As these amenities became overcrowded, the CoCT opened up more community halls, unused school buildings and other public facilities[13]. From 25 May, these sites were closed one by one and people were moved to five Centre of Safety Sites (CoSS). In turn these were also closed, although foreign nationals remained at two of the sites beyond October 2008.

The timeline for the emergency is shown in Figure 4.2.1. It illustrates how these events spanned the period from May 2008 to April 2010. They took place during Cape Town's bitter winter months, which, in 2008, were characterised by exceptionally heavy seasonal rain and widespread flooding in informal settlements.

Did you know?

- Social violence refers to planned or spontaneous, large-scale threatened or actual interpersonal violence against a particular group or in support of a specific agenda
- It is most accurate to refer to those affected by the violence in South Africa and who have fled their homes as 'displaced people'
- Those displaced were primarily foreign nationals already living outside their countries, so they do not fit the definition of *internally displaced people* (IDPs)
- Some of those displaced were refugees, but many were simply migrants living and working in South Africa who were able to return home

Figure 4.2.1 Social violence emergency: sequence of events, May 2008–April 2010

May 11 2008	Violence breaks out in Alexandra township, Johannesburg Attacks spread to other townships and informal settlements in Gauteng
May 21 2008	The Western Cape's Police Commissioner establishes a Safety Forum A 24-hour helpline is established at police stations
May 22 2008	Violence breaks out in Du Noon: Informal homes are destroyed and looted; one person killed 500 foreigners seek refuge at Milnerton police station
May 23 2008	Cape Town's Disaster Risk Management Centre (DRMC) activates its Disaster Operations Centre (DOC) A mobile Joint Operations Centre (JOC) is established at Killarney Race Track to assist people fleeing Du Noon Attacks are reported elsewhere in the Western Cape City of Cape Town (CoCT) prepares Centre of Safety Sites (CoSS)
May 25 2008	It is estimated that more than 20,000 people are being accommodated at sites throughout the city The CoCT begins moving people to Centre of Safety Sites
June 04 2008	The Premier declares the events a provincial disaster
August 30 2008	CoCT begins consolidating five CoSS in to three sites, transfers displaced people from private sites to the remaining CoSS
September 03 2008	Government officially ceases bulk of humanitarian aid
October 10 2008	The first of the remaining CoSS, Harmony Park, closes
October 17 2008	The second CoSS, Youngsfield, due to close, but non-nationals remain on site; government suspends assistance
October 31 2008	Last CoSS, Blue Waters, due to close, but non-nationals remain on site; government suspends assistance Site remains open
May 2009	Youngsfield CoSS due to close, but remains open
April 21 2010	Blue Waters closes as a result of court order A group of 37 refugees is arrested for trespassing
April 29 2010	Last site at Youngsfield, with 64 foreign nationals, closed

At time of going to print, the CoCT estimated its expenditure for the social violence emergency to exceed R200 million (2010 values). The City reported receiving not more than R17.3 million (2010 values) from National Treasury to support its response.

4.3 Why was the social violence so different from other emergencies?

The social violence of 2008 differed significantly from the 'usual' disasters such as winter flooding or informal settlement fires. Since the promulgation of the Disaster Management Act (2003), disaster managers had not yet faced an entirely socially produced 'human-induced' hazard. There are important differences between the two types of emergency; these are shown in Table 4.3.1.

Table 4.3.1 Social violence: a new type of hazard

Dynamics that were new or different	Why were these different?
Scale of the event: – No. of people affected – Dispersed spatial scale – Rapid speed of onset	Seasonal flooding and even large informal settlement fires usually occur in defined localities within the city. However, in this instance, the fact that a large number of displaced people were dispersed widely across the city created huge response challenges. The difficulties were compounded by the rapid speed at which the emergency unfolded.
Prolonged **duration**	Severe weather events and fires last for a few hours, or at most days. However, the violence continued for several months. This prolonged the duration of the displacement, as people were afraid to return to their homes. It also placed unprecedented demands on government resources and voluntary organisations.
Involvement of more diverse local, national and international **actors**	For expected emergencies such as informal fires and seasonal flooding, the CoCT has well-established co-operation arrangements with a limited number of local NGOs and service providers. This emergency involved a much wider range of civil society actors compared to the usual seasonal threats. Many of these groups had limited prior experience with working with disaster management. It was also the first time that governmental and non-governmental role players had worked with international humanitarian assistance partners (such as, United Nations agencies, Oxfam and MSF.[14]) This led to differing expectations of standards for humanitarian assistance. With regards to the CoCT specifically, the provincial administration's greater involvement also presented new challenges. These included underlying tensions between the two opposing political parties administering the province and the city. They were further compounded by the timing of the emergency, which occurred less than a year before scheduled national elections.
Diverse **backgrounds of the affected population**	Prior to the crisis, disaster managers and local relief agencies had responded primarily to emergencies involving South African citizens. However, this event affected mainly foreign nationals from a range of cultural, religious, social and economic backgrounds. People spoke different languages and sometimes limited English. They also had different food preferences. This diversity made many familiar modes of relief support, communication and organisation inappropriate or redundant.[15]

4.4 How important was the civil society response?

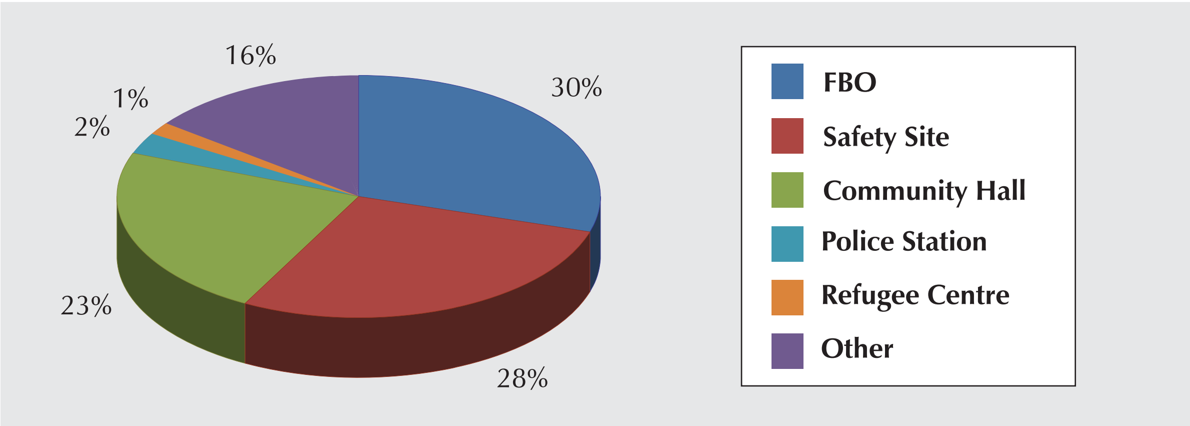
Civil society played a key role in the response, particularly at the onset of the crisis. In addition, the DRMC activated its DOC (Disaster Operations Centre) almost immediately, and was able to implement its cross-sectoral response plan shortly thereafter. This was despite the complexity and fast-paced nature of the emergency.

Faith-based organisations (FBOs), in particular, provided shelter and mobilised a huge relief effort (see Graph 4.1.1).[16] As the response actions progressed, civil society actors took on a range of roles, including direct welfare provision and monitoring. Some civil society organisations worked alongside government to fill assistance gaps, while others took on an oversight and advocacy role.[17]

What is civil society?

Civil society refers to voluntary civic and social institutions. These include FBOs, community groups, charities, development non-governmental organisations (NGOs), social movements, advocacy groups and trade unions.

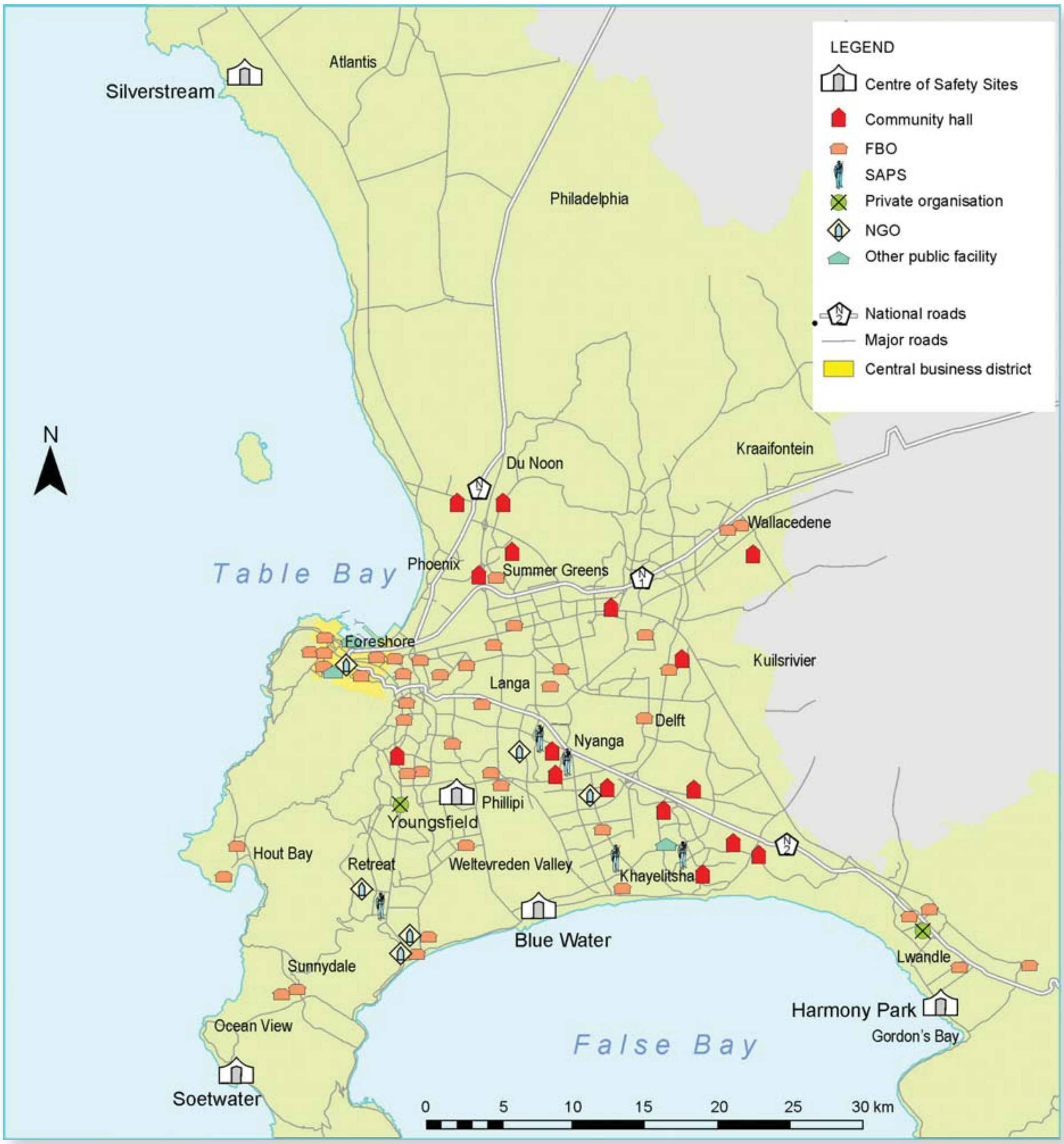
Graph 4.4.1 Proportion of displaced people sheltered at different sites by 31 May 2008



Graph 4.4.1 shows that by the end of May 2008 more than half of all the displaced people were either being temporarily sheltered by FBOs (29.1%) or accommodated in community halls (22.4%). Civil society organisations – largely through the efforts of dedicated volunteers – were primarily responsible for relief at these sites.

Map 4.4.1 shows just how important FBOs and community organisations were in responding in the early stages of the emergency. This is because they were spread widely across the city, and provided sites that were regarded as 'safe' sources of refuge. Over 100 different sites provided safety and refuge in the first days of the emergency.

Map 4.4.1 Distribution of refuge sites at the peak of the May 2008 crisis



Civil society organisations were an important resource. Some provided specific skills in areas in which government had less capacity, such as human and refugee rights, conflict resolution and mediation.

NGOs also provided oversight and addressed gaps that overstretched government departments could not fill. One example was the Treatment Action Campaign's (TAC) data gathering and monitoring of the CoSS. This showed how a civil society organisation can support planning and service delivery in complex emergencies.

4.5 Is xenophobic violence still a risk in the Western Cape?

Although the 2008 crisis is over and the safety sites have closed, the risk of violence and displacement has not disappeared. Since 2008, there have been incidents of xenophobia-related violence reported in De Doorns, as well as continuing, sporadic attacks on foreign nationals and their businesses elsewhere. The green circles on Map 4.5.1 show examples of locations where such incidents have occurred.

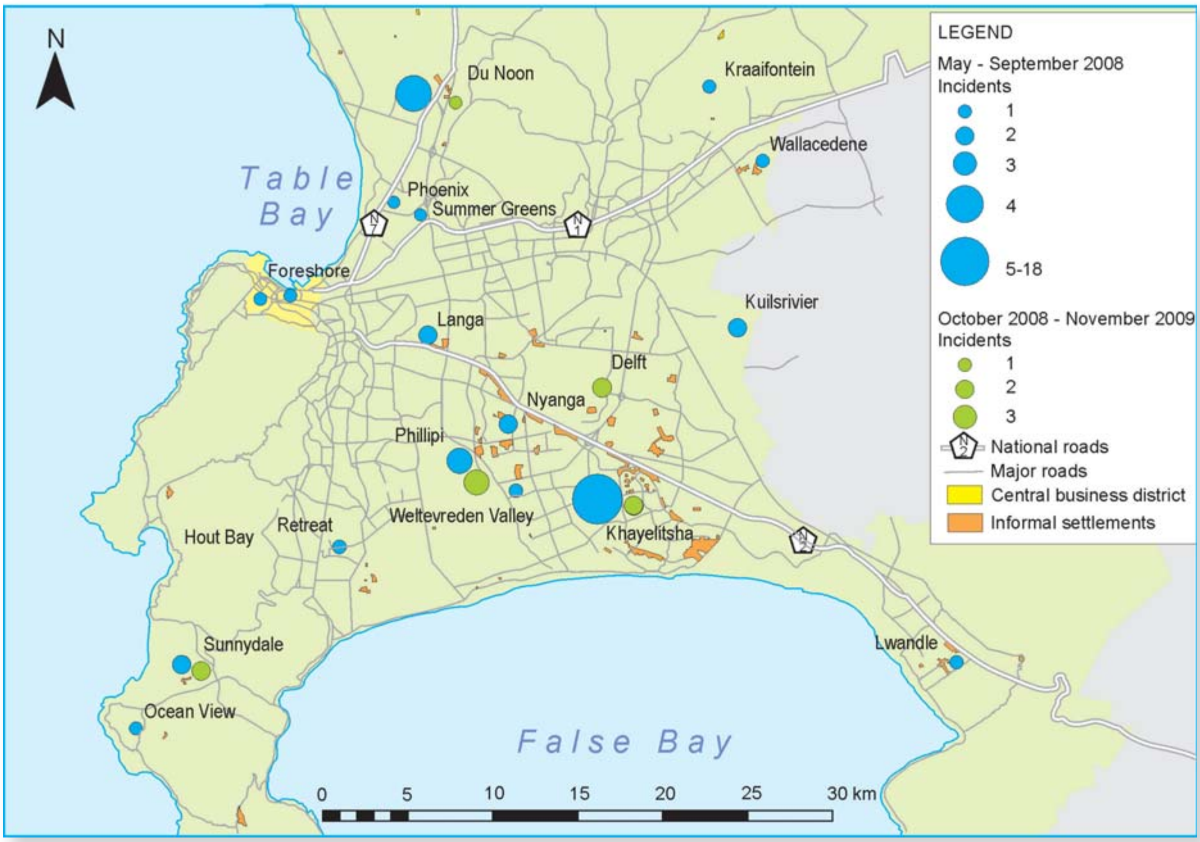
The ongoing attacks also highlight similarities between xenophobic violence and expected urban risks such as informal fires or flooding. Although apparently triggered by different hazards, these threats share many of the same social and economic risk factors. Because the complex root causes remain unresolved, the risk of violence and potential for mass displacement still exist.

Good risk management requires two complementary approaches:

- Avoiding an occurrence of the event if possible (i.e. to prevent the risk from being 'realised' in an incident or disaster)
- Having effective capacity to manage the incident or disaster if it does occur (i.e. to keep losses, displacement and hardship as low as possible)

In the City of Cape Town, these risk management approaches are well developed for informal settlement fires and urban flooding. The same strategies can also be applied to xenophobia-related violence.

Map 4.5.1 Locations of reported xenophobic violence, May 2008–November 2009



4.5.1 What measures can help avoid outbreaks of violence?

Tackling the root causes of xenophobia-related violence will require long-term support and political commitment. In the meantime, we should focus on preventing any future outbreaks. We should also try to contain incidents when they do occur, and keep people safe within their communities.

Two measures that will help avoid outbreaks of severe violence are:

- Careful monitoring of violence 'hotspots' as well as of potential for attacks
- Promoting dialogue and conciliation in at-risk communities through the support and intervention of the Department of Social Development (DSD)

Improve the tracking and monitoring of violence 'hotspots'

Just as we monitor areas prone to fires or winter flooding, we could also track violence hotspots to monitor the potential for attacks. The establishment of an 'Early Warning Unit' to track and analyse information that signals rising community tensions has been suggested by the Office for the Coordination of Humanitarian Affairs (UNOCHA) as a possible intervention to help improve the identification and monitoring of hotspots.[18]

The maps in *RADAR* illustrate just how useful this kind of consolidated information is for pointing out high-risk areas. They also show how maps can help record the location of community-based resources that might help manage an outbreak of violence or other dispersed emergency (see Map 4.4.1). This information not only allows us to be more strategic in managing the risk of xenophobic violence, it can also guide pre-emptive action when tensions increase, for instance through the timely support and intervention by the Department of Social Development (DSD) and other organisations with expertise in conflict resolution.

Community-based monitoring for social violence should also be complemented by the efforts of entities such as the National Intelligence Agency (NIA). In this context, it is essential that information indicating an escalation in risk conditions is communicated to the national, provincial and municipal departments tasked with reducing and managing social conflict.

Who is a refugee?

The most widely applied definition comes from the UN Refugee Convention of 1951, which defines a refugee as a person who has fled or can not return to their country of birth, or has been left stateless due to a well-founded fear of:

- Persecution due to their race, religion, nationality, membership of a particular social group or political opinion
- Serious threats to their life, physical integrity or freedom[19]

Who is an Internally Displaced Person (IDP)?

There is no legal definition of an IDP, but the Guiding Principles on Internal Displacement adopted by the UN in 1998 identify them as people who have been forced to leave their homes as a result of or to avoid conflict, violence, or human rights violations disasters, but whose displacement has not taken them across an internationally-recognised border[20].

Promoting dialogue and conciliation at in at-risk communities

Outbreaks of violence can also be prevented at community level. The examples in the box below show how efforts to engage leaders, foreign nationals and other community members helped to build understanding, tolerance and protection of foreigners.

Community-level efforts to prevent and address violence

In Thabo Mbeki informal settlement on the Cape Flats, community leaders emphasised the value of foreign nationals, and made it known that violence would not be tolerated.

In parts of Site B in Khayelitsha on the Cape Flats, youth groups spoke out against the violence in other areas, and went door to door to ask for tolerance and understanding.

In Masiphumelele, near Noordhoek, community leaders joined forces to help displaced people reintegrate. As in other parts of CoCT, many foreign nationals had fled even before the attacks in Du Noon, and more followed as news of the attacks spread. On 23 May, religious leaders called a meeting of community leaders, where they decided to help reintegrate the displaced. Following reports of looting, community leaders went from door to door to reclaim property stolen from vacated shops and homes. On 25 May, a group of community leaders visited the Soetwater CoSS, where most of the displaced people from Masiphumelele were being temporarily sheltered. There they apologised to the foreign nationals for wrongs committed against them and undertook to protect those wishing to return.

Those who opted to return were escorted back into the settlement, and each community leader took responsibility for a small group of returnees. They made sure that stolen property was returned, and personally went from door to door to ‘reintroduce’ their displaced neighbours to other community members. Leaders also made a point of promoting reconciliation and tolerance.

Figure 4.5.1 May 25 2008: A Masiphumelele resident welcomes back her Somali neighbour, after a public apology to victims of social violence and an invitation to them to return to the settlement.

4.5.2 How can we manage outbreaks better when they do occur?

Lessons from the xenophobic violence of 2008 were that:

- Emergency and humanitarian response should be a last resort
- Prolonged displacement requires a different kind of response

In this emergency, the sheer numbers of people seeking shelter, and their diversity and prolonged displacement, placed exhausting demands on government and civil society. Hundreds of government employees and civil society volunteers worked tirelessly for months, assisting with relief and then with the complex processes of reintegration.

These demands differed significantly from the short-term displacements usually associated with seasonal flooding or informal settlement fires. They also showed how new risks, such as the potential for xenophobic violence, provide opportunities to rethink and adjust our practised emergency approaches.

Some of the elements of an adapted approach to social violence are shown in Table 4.5.2.1. Of course, there are other requirements too, such as improved contingency plans and the clear designation of a 'lead' government department in coordinating responses.

Table 4.5.2.1 Measures that will improve management of xenophobic violence emergencies

Measures required to improve management of xenophobic violence	Why measures are necessary:
Use warning information to identify 'hotspots' and contain the spread of violence early	Diffusing community-level tensions and keeping people safe in their residential areas may avert an escalation of violence. This is more resource-intensive initially, but avoids long-term costs on government and civil society.
Increase consultation between government and civil society	Improving consultation between government and civil society organisations strengthens co-ordination and accountability. The Western Cape has a wealth of civil society groups, willing and able to assist. These are a real resource.
Involve other institutional actors	Including agencies such as the UN and other humanitarian response organisations draws on their expertise in complex humanitarian emergencies. Engaging the media proactively also mobilises a valuable resource.
View affected people as stakeholders, not beneficiaries	Engaging affected people as stakeholders rather than passive aid recipients improves the effectiveness of the response, as does involving them actively in decision-making. The presence of competent Safety Site managers (or 'co-ordinators') encourages and streamlines communication between the affected people and assistance agencies.

To sum up...

- The social violence against foreign nationals in May 2008 was one of the most complex emergencies seen in South Africa. Nationally, over 60 people were killed, while between 80,000 and 200,000 people were displaced and sought refuge.
- At the height of violence, between 20,000 and 22,000 people were displaced in CoCT. Up to 30,000 people may also have left the city in the first few days after the violence began.
- People first sought refuge at more than 100 police stations, churches, mosques and other religious and private facilities, as well as CoCT's other venues.
- This was a different type of emergency, which placed new demands on both governmental and non-governmental actors. This was due not only to the scale of the humanitarian need, but also the sheer complexity of the response needed.
- The social violence emergency was also particularly challenging due to its prolonged duration and the involvement of a diversity of local, national and international actors.
- It was further complicated by the diverse cultural, religious, social and economic backgrounds of those displaced.
- Two key measures to help avoid outbreaks of severe violence in the future include improving the monitoring of violence 'hotspots' and promoting dialogue and conciliation in at-risk communities.

When storms collide…

When we think about risks, we separate them into 'silos', such as health risks, criminal threats or economic uncertainties. In the case of disaster risks, we usually separate those that are triggered by natural processes (often known, misleadingly, as 'natural' disasters), from events that originate from technological hazards and those that are human-induced.

This means that approaches for managing humanitarian emergencies such as refugee displacements are often separated from responses for naturally-triggered risks, like severe storms and floods.

Chapter 5 shows that such distinctions are often artificial, by using maps to illustrate how storms of both atmospheric and human origin collided in the City of Cape Town (CoCT) from May to August 2008. Together, these threats resulted in a combination of social violence and displacement, as well as serious winter flooding and severe storm damage.

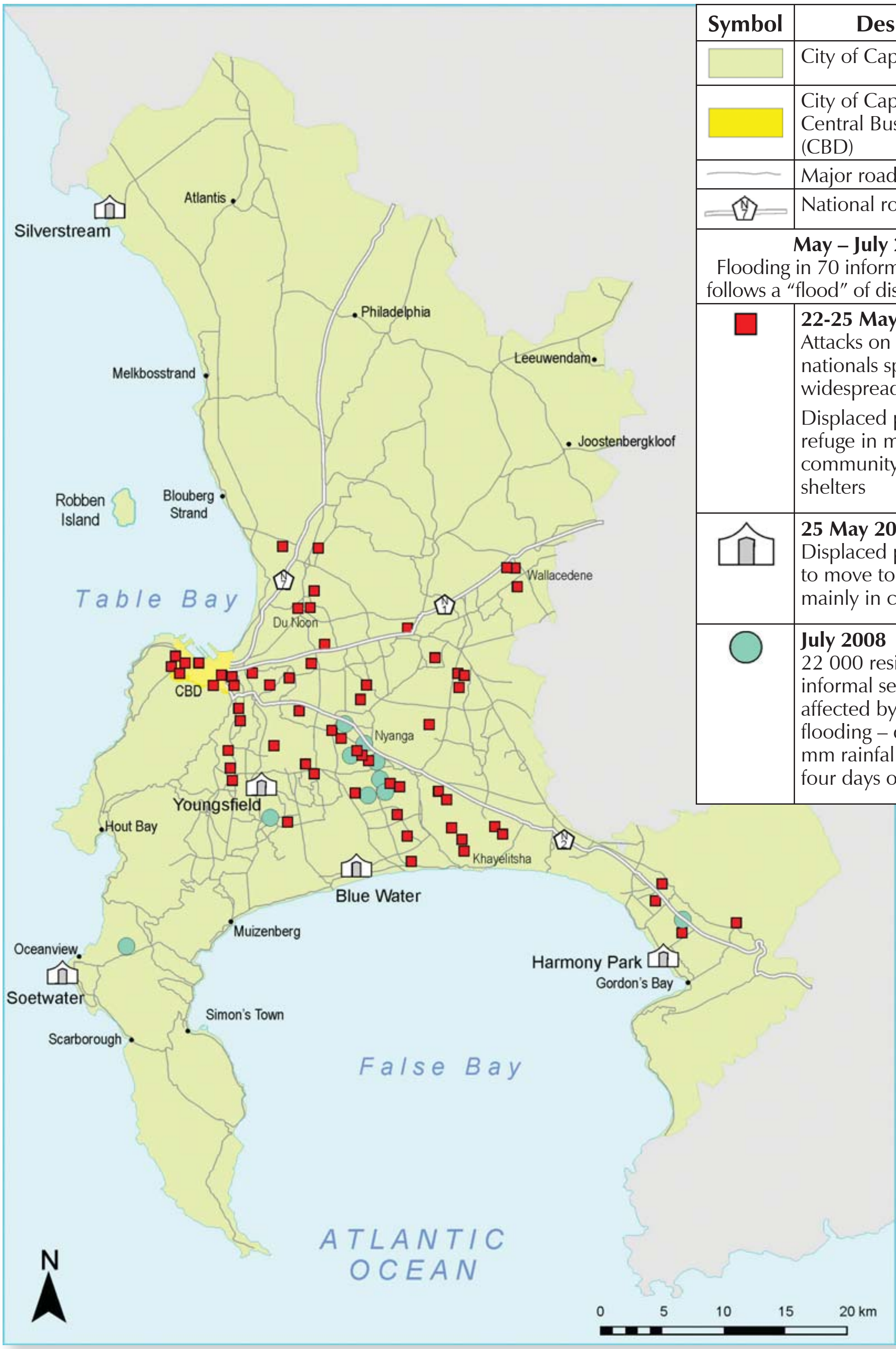
The chapter presents the difficulties of managing complex and multiple threats in a large and diverse city. This was clearly illustrated by the decision to site the Centres of Safety (CoSS) in locations considered safe from exposure to violent attacks – but which were then directly exposed to severe weather and flooding during Cape Town's bitter winter storms.

It also shows the value of conducting 'ex-post' (or post-disaster) research and mapping disaster events as they unfold – to inform future risk-management planning.

Photograph showing UNHCR tents allocated to displaced people at Bluewaters Centre of Safety Site that provided shelter to family units of 4-6 members.

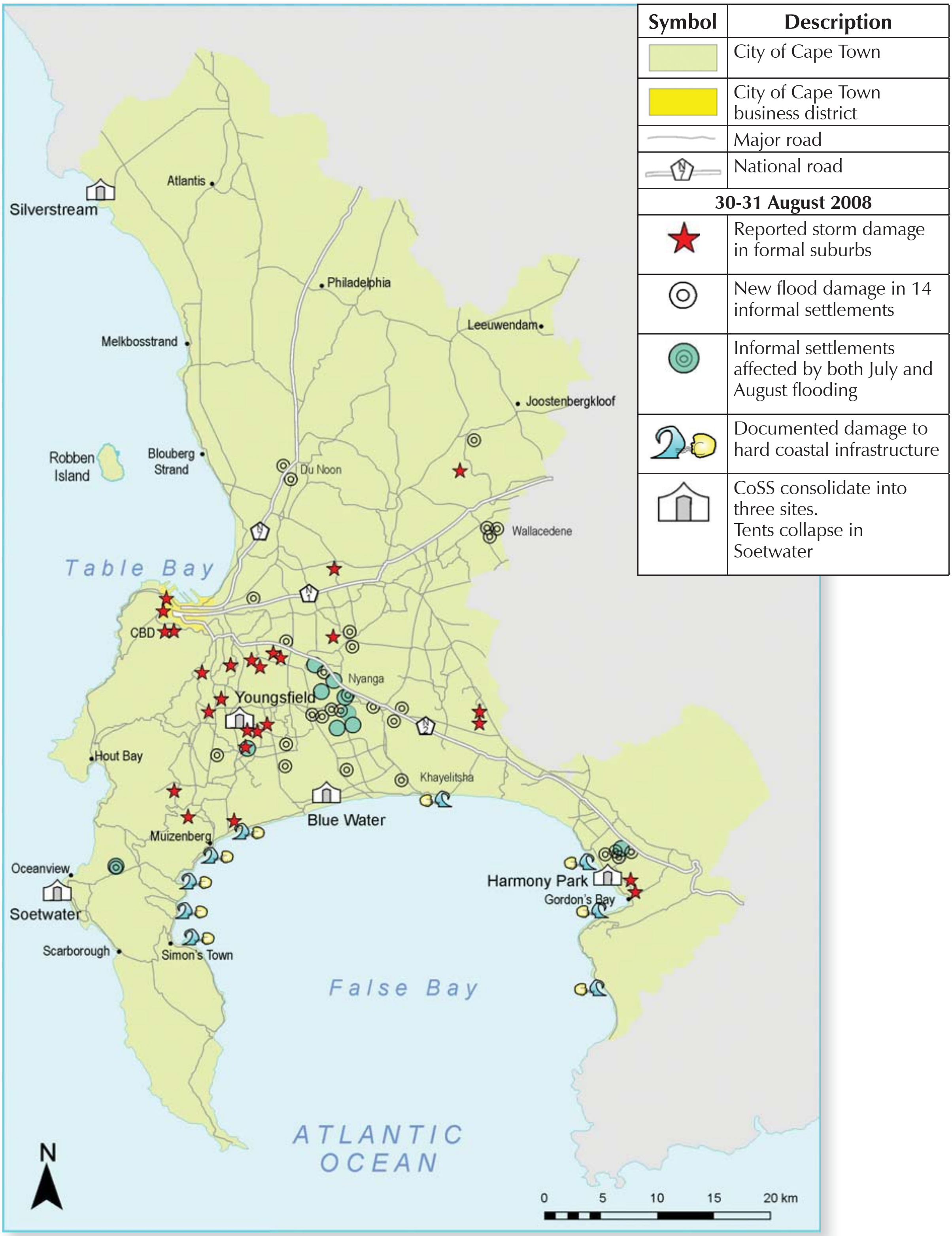
Photograph taken of Bluewaters on 30 August 2008, when family tents collapsed in the severe storm. These were then re-erected inside the larger marquee tents for privacy and protection from the elements.

Map 5.1.1 May to July 2008: Flooding in 70 informal settlements follows a "flood" of displaced people



Symbol	Description
	City of Cape Town
	City of Cape Town Central Business District (CBD)
	Major road
	National road
May – July 2008 Flooding in 70 informal settlements follows a "flood" of displaced people.	
	22-25 May 2008 Attacks on foreign nationals spark widespread displacement Displaced people seek refuge in more than 100 community and other shelters
	25 May 2008 Displaced people begin to move to CoSS, located mainly in coastal areas
	July 2008 22 000 residents in 70 informal settlements affected by severe winter flooding – due to 117.2 mm rainfall over the first four days of the event.

Map 5.1.2 30-31 August 2008: A severe storm batters the city, with damage to coastal infrastructure



To sum up...

- The period May–November 2008 was a time of intense pressure for disaster risk management services in the Western Cape
- In May, there was widespread xenophobic violence and displacement across the province, followed in July by cut-off low impacts along the West Coast and informal settlement flooding in the CoCT
- At the end of August, a severe storm struck the CoCT; while in November, a powerful cut-off low and related flooding resulted in costly damage in the Winelands and Overberg
- The map sequence for the CoCT specifically profiles the multiple pressures that converged in the Cape Metro. It shows how from May to August, more than 44,000 foreign nationals and informal settlement residents were affected or displaced, either by social violence or by flooding within the city
- The sequence also highlights how historic distinctions between 'naturally triggered' and 'human-induced' threats are often artificial – especially in African cities that are increasingly complex, socially and environmentally
- This chapter illustrates the value of mapping observed and reported impacts from multiple governmental and civil society sources to identify high-risk locations, as well as community resources for improved risk management

Emerging resources – linking up with local 'movers and shakers'

The Western Cape is rich in often untapped human resources. These are local people with kindness and compassion; residents who willingly give of their own time and apply their particular strengths and expertise for the good of their communities. They are also often the 'movers' in that they seek creative solutions to the risks they face, often without additional resources.

These efforts by volunteers and civil society groups across the province have strengthened the capacity of local municipalities in general, and disaster managers in particular. This is especially the case in far-flung rural areas that lack financial resources. Often building on humble beginnings and working patiently and tirelessly, these dedicated individuals and groups have grown from strength to strength over the last few years.

In the course of our research for *RADAR*, we discovered many exciting local initiatives. This chapter offers a snapshot of six of them. Each is unique, drawing on a variety of strengths and expertise and showing how local residents and disaster managers can work together effectively.

Of course, these case-studies are not the only instances of community members actively engaged in disaster risk reduction in the province. However, they emphasise the value that is added when risk management efforts are energised by local 'movers and shakers'.

Children working together to clean-up litter in a flood-prone informal settlement in Cape Town. Community-based efforts such as this can successfully reduce the severity of flood damage, by helping keep stormwater systems free of debris.

6.1 Mobilising for flood preparedness

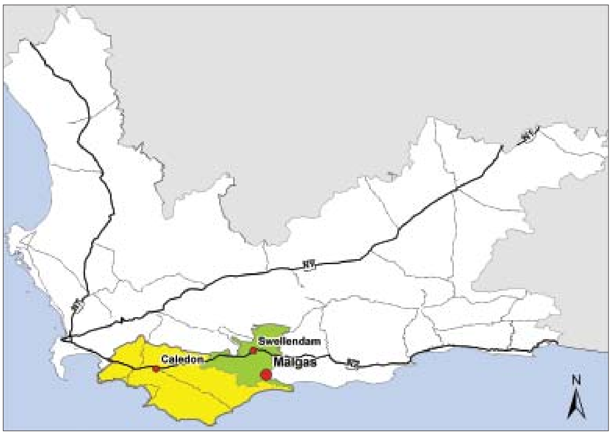
The Malagas Residents' Association (MRA)

Chapters 2, 3, 4 and 5 have shown how complex it is to manage the effects of severe storms. They have also highlighted areas that are repeatedly affected by severe weather and flooding.

There has been real progress, however. In some of the Western Cape's most flood-prone towns, the repeat knocks have stimulated innovative local risk management initiatives. These have often been spearheaded by an existing residents' association.

This case-study shows how the residents of Malgas mobilised together to reduce their flood risks after the November 2008 cut-off low. It also highlights the central role of active residents' associations in flood-preparedness planning.

Map 6.1.1 Location of Malgas (previously known as Malagas)



For more information on:
MRA: P. Jaques on pajaques@mweb.co.za
LBRC: www.breede-river.org
ODM: R. Geldenhuys (028) 425 1157

Aftermath of the 2008 floods – the MRA gets involved

After the damaging Breede River floods of November 2008, the MRA called a general meeting to discuss how to manage flood events better. This marked the beginning of a constructive risk management collaboration that involved the Overberg District Disaster Manager, the Swellendam branch of the South African Police, Swellendam municipal officials, the Lower Breede River Conservancy (LBRC) and members of the local farming community.

With guidance from the Overberg District Disaster Management, the MRA drafted a comprehensive incident/disaster management plan that was circulated to all residents. The plan addressed the following priorities (see Flipchart 6.1.1).

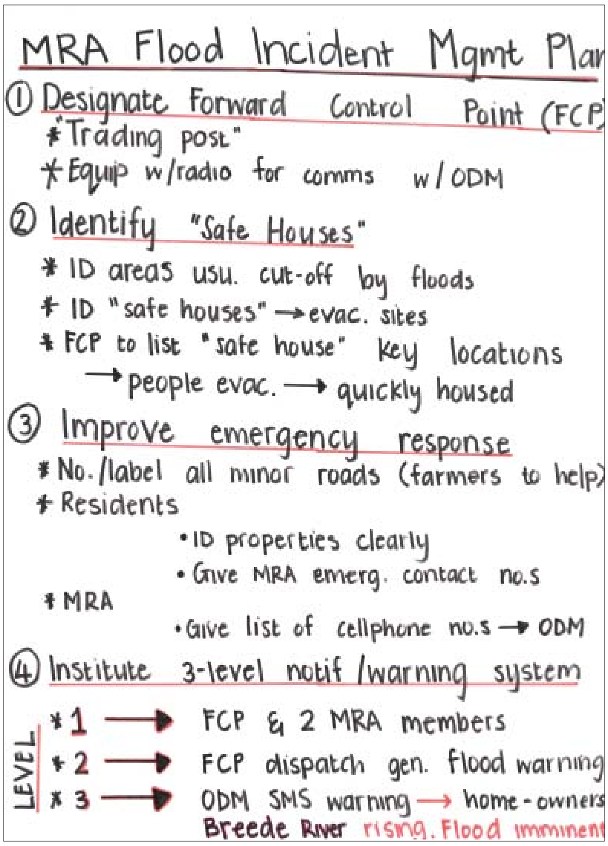
Figure 6.1.1 Flood severity, Malgas, 2008 – a 100 year flood for the Breede River

Making the most of modest resources – the MRA and Overberg Disaster Management

There was no injection of extra funds for this plan. However, the MRA financed the installation of an FCP radio from its member contributions, while Overberg Disaster Management agreed to maintain and service the local fire truck.

The Flood Incident Management Plan has already helped improve the handling of other risks. For instance, the MRA team assisted the Overberg District disaster manager when wildfires burned over a five-day period in 2009. This fire response was reportedly faster, more efficient and timeous than previous instances, largely because the MRA could adapt the incident management plan that they had originally developed for flooding.

Flipchart 6.1.1 Priorities identified by the MRA for their flood management plan



Did you know?

- The flood of 1906 was actually the highest ever recorded, with water levels that still exceed those of the November 2008 flood
- The LBRC is mapping the new high water mark (from the 2008 floods) along the river banks, using GPS as well as photographs from the November floods
- The farmers' association is developing a more robust flood early warning system
- The MRA, together with local farmers' associations and the LBRC, is working to advise local residents regarding storing property above the new flood line

6.2 Harnessing technology for early warning

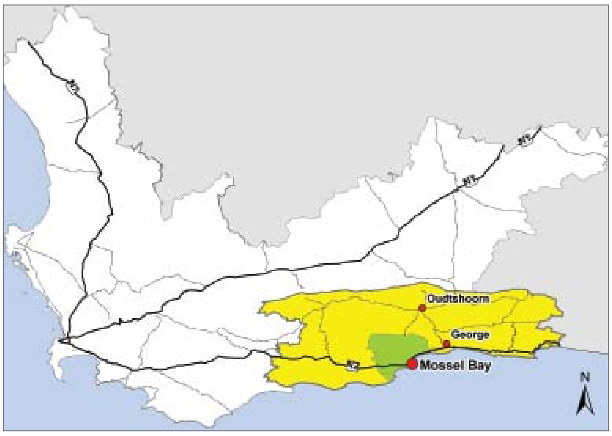
Amateur Radio and the SAWDIS

Good emergency management before, during and after severe storms depends on access to real-time weather warnings.

This example from Mossel Bay shows how radio amateurs and HAMNET members, as well as the general public, can play an important role in reporting real-time weather and disaster information – and offer a key public information service during emergencies.

It also illustrates how members of the public, using their own equipment, can contribute positively to disseminating critical information when and where it is needed most.

Map 6.2.1 Location of Mossel Bay



For information on:
SAWDIS: mailto:sawdis05@gmail.com
HAMNET: http://saweatherobserver.blogspot.com

Aftermath of floods – SAWDIS is established

For Mossel Bay radio ham Johan Terblanche, the poor quality of public information available during the 2006/2007 floods convinced him of the need for a local public weather and disaster information service, and especially an early warning system.

With the support of other amateur radio operators (known as radio hams) and the general public, he established the South African Weather and Disaster Information Service (SAWDIS) and associated Internet blog in October 2008. The blog provides up-to-the minute weather reports, weather maps, photographs, satellite images, and relevant information on disasters around the world.

This approach of harnessing the Internet for local disaster risk management caught on quickly, and as an awareness of SAWDIS spread, additional external links have gradually been added to the blog, making it an increasingly valuable resource.

Figure 6.2.1 Johan Terblanche in his SAWDIS station

How does SAWDIS work?

SAWDIS allows information to be exchanged effectively by using the Internet, commercial entities and amateur radio operators. This two-way information flow helps to promote and improve scientific methodologies as well as helping to interpret weather and disaster observations at grass roots level.

The 'high-tech' element of SAWDIS relies on the *APRS RF* global system. This is a combination of networks and terrestrial and satellite links that move weather-related information around the world. In South Africa, many areas lack the necessary infrastructure and knowledge to benefit from this global information.

This is where the 'low-tech' side of SAWDIS steps in. Amateur radio operators receive and share information, linking isolated and marginalised communities with real-time weather forecasts from satellites and other sources.

SAWDIS currently receives neither funding nor sponsorship, and is built on the dedication, imagination and skill of its volunteers.

Did you know?

- *APRS RF* refers to Automatic Packet Reporting System
- SAWDIS has 61 amateur weather watchers
- There are 1,328 active amateur radio operators in South Africa
- SAWDIS has 208 records (of flood and fire images), mainly on disasters in the Southern Cape, in its web-retrievable archives

6.3 ‘Home-grown’ flood early-warning systems

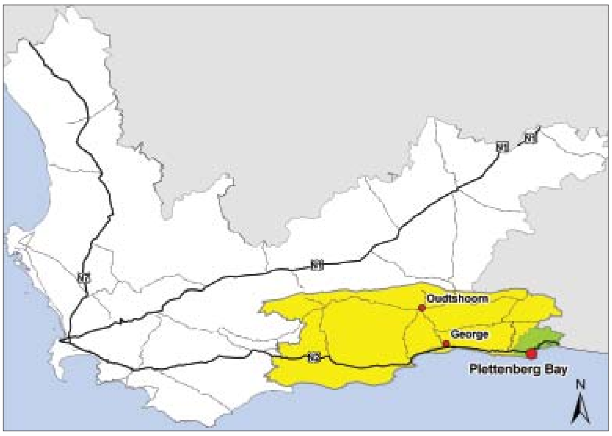
National Sea Rescue Institute (NRSI), Plettenberg Bay

Regional weather forecasts alert us to approaching storms and other weather threats. However, severe storms can generate quite different impacts, depending on prevailing local conditions and capacities.

In the Western Cape, many towns and rural areas have developed their own early warning systems for storms and severe weather. These approaches, based on local knowledge and experience, have been invaluable in guiding local preparedness and response plans.

The flood early-warning system developed by NSRI Station 14 in Plettenberg Bay (‘NSRI Plett’) is profiled below. It highlights how local knowledge of rainfall patterns can improve flood warning and response, especially when harnessed by a skilled and dedicated rescue organisation.

Map 6.3.1 Location of Plettenberg Bay



For information on:
NSRI: www.nsri.org.za
NSRI Plett: http://plettyamaha.co.za/nsri

NSRI Plett: An outstanding 40-year track record

The NSRI Plett was officially commissioned in July 1971, and began operating from a shed on Central Beach with just one six-metre-long craft equipped with two motors. It now boasts 32 active members, who have expertise ranging from seamanship to medical support for on-land activities.

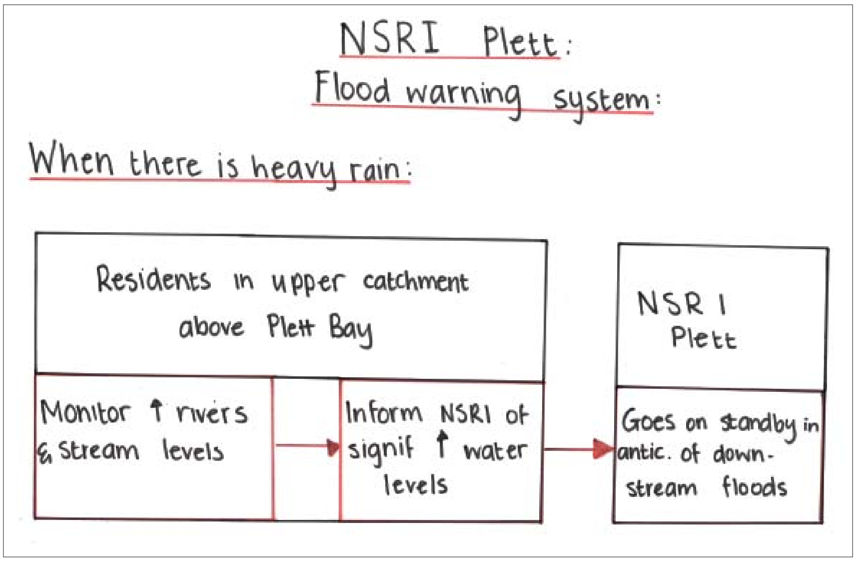
It is one of the busiest NSRI branches in South Africa and is responsible for emergency call-outs from Kranshoek Lookout Point in the west, to Oubaai (east of the Storms River mouth) – a total of around 4,500 square kilometres. It responds to hundreds of life-threatening situations every year, working closely with other emergency services. Its volunteers are also called to help out in non-marine emergencies, due to their medical and response training. These can include car accidents and even wildfires.

Figure 6.3.1 The NSRI launch boat rescues stranded motorists during a flood event

Fine-tuning flood early warnings

This NSRI station has monitored local flooding and changing rainfall patterns for many years. However, after recent repeated severe weather events, its staff realised they needed a more ‘fine-tuned’ and localised flood early warning system. Their new approach links information on upper catchment rainfall and water levels to the likelihood of downstream flooding. This strategy has already proved useful for local conditions, complementing the generalised regional weather forecasts. The following box summarises the key steps in NSRI Plett’s ‘flood warning chain’.

Flipchart 6.3.1 How the NSRI local flood warning system works in Plettenberg Bay



Did you know?

- The NSRI is a non-profit organisation with 29 coastal stations as well as three inland branches located on dams
- It was founded in 1967, after a trawler sank off the Still Bay coast in 1966 and 17 fishermen drowned
- The NSRI’s first rescue boat was called Snoopy, and was donated by the Society of Master Mariners
- The Plettenberg NSRI base has a specialist Air Sea Rescue Team, which has working methods based on U.S. Coast Guard standards
- At any time, the Plettenberg Bay crew are able to launch their boats within three minutes after the beach siren sounds

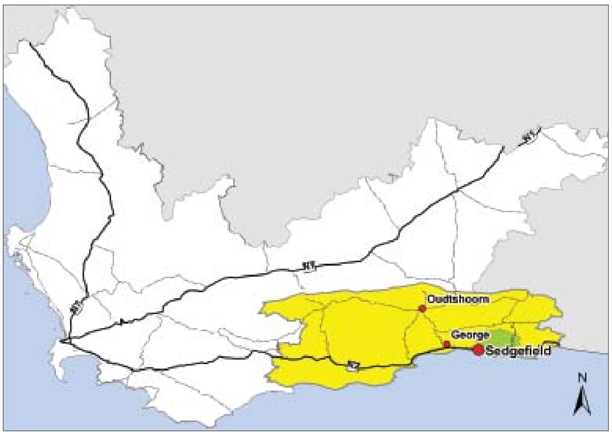
6.4 Tapping local expertise to stop flood damage

Sedgefield residents get proactive

Good flood risk management depends on robust research that in turn requires technical skill. In South Africa, many of our retired professionals have a wealth of expertise and knowledge that can assist this process. They also have the time and often the resources to 'make things happen'.

This example from Sedgefield in the Southern Cape shows how retired, skilled professionals can help spearhead flood risk management in an ecologically-fragile and flood-exposed area. It highlights how their expertise can enhance understanding of complex flood risks. It also illustrates how co-operation between disaster managers and local residents can improve local flood-contingency planning and early-warning systems.

Map 6.4.1 Location of Sedgefield



For more information on: Sedgefield Flood Action Committee or the Friends of the Swartvlei:
Sedgefield.Ratepayers@gmail.com

A spectacular location – but flood damage mounts

The coastal village of Sedgefield is situated between George and Knysna on the banks of the Swartvlei Estuary. For many years, the Choo-Tjoe steam train crossed this estuary, providing fantastic photographic opportunities for steam train enthusiasts from all over the world. However, in August 2006, heavy rains forced the closure of the line between George and Knysna, and in November 2007 large parts of the rail embankment across Swartvlei Estuary were washed away.

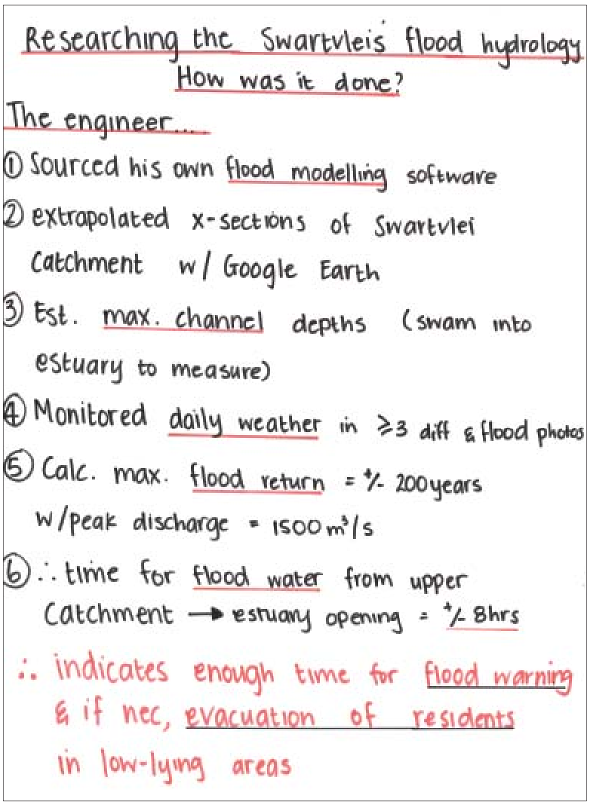
Figure 6.4.1 Sedgefield flood, November 2007

After the floods – Sedgefield residents get active

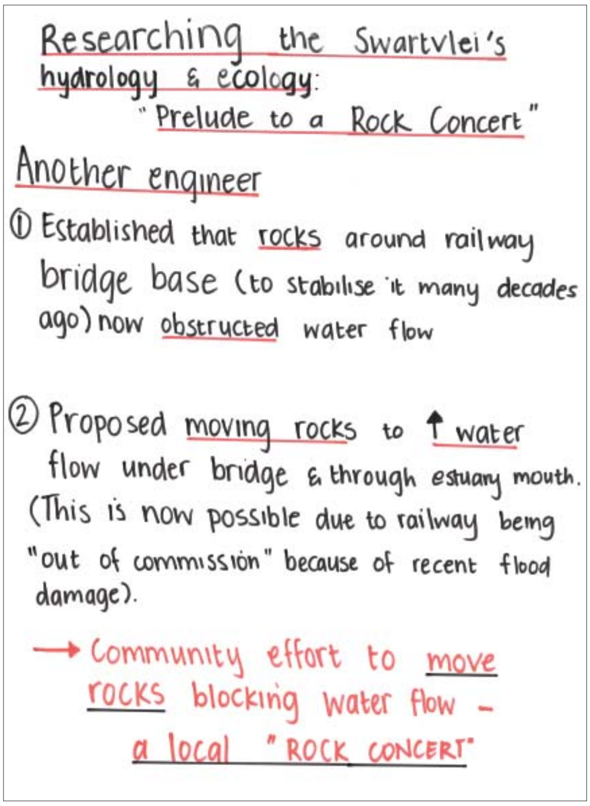
After the massively damaging floods in 2003 and 2007, local interest groups and concerned residents joined forces with the Sedgefield Ratepayers and Voters Association to reduce the risk of repeat flooding and to protect their estuary's health. Two groups that led this initiative were the Friends of the Swartvlei and the Sedgefield Flood Action Committee.

While there are many scientific and private sector groups that study floods in South Africa, two retired civil engineers took the lead in researching flooding in Sedgefield. The following flipcharts summarise the steps they took to study the local flood context – generating results that have already informed local flood risk management.

Flipchart 6.4.1 Outline of steps taken during flood hydrology research



Flipchart 6.4.2 Local research to reduce flood severity in Sedgefield



Eden disaster management and Sedgefield residents team up

Since the November 2007 floods, Sedgefield residents and the Eden District Disaster Manager have worked together on a flood contingency plan. There is now a new local early-warning system in place. This actively includes Sedgefield residents, the Eden Disaster Manager, the Knysna Disaster Manager and the South African Weather Service.

These efforts have been funded mainly by the concerned individuals and groups themselves. The work on the railway bridge, for example, was organised by the Friends of Swartvlei and co-financed by the Knysna Municipality, local residents and visitors.

Did you know?

- Rain that falls in the steep catchment areas above Sedgefield takes eight hours to reach the mouth of the Swartvlei estuary
- The Swartvlei is fed by three river catchment systems, namely Hoëkraal River, Karatara River and Wolwe River
- The Sedgefield Flood Action Committee was formed after the floods of 2007, when five concerned residents experienced severe flood losses after which their insurance companies withdrew cover against flood risks

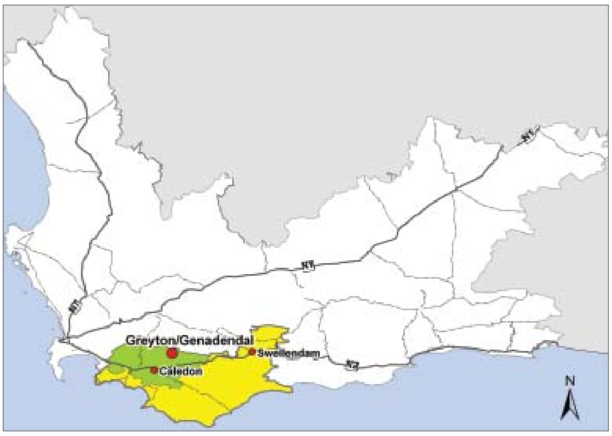
6.5 Filling social relief gaps

The Greyton/Genadendal Branch of the South African Red Cross Society (SARCS)

In many remote, rural areas, government services are spread thinly and overworked, and this is even more the case during emergencies. This means that in many of the Western Cape's isolated towns and villages, community-based organisations play key development roles, especially in poorer areas.

This example from the Greyton/Genadendal Branch of SARCS shows how its volunteers' energies and commitment have made a developmental difference in the Theewaterskloof Municipality. It also illustrates how the Red Cross has grown from small and modest beginnings to become the municipality's lead partner for social relief in times of need.

Map 6.5.1 Location of Greyton/Genadendal



For information on SARCS Greyton/Genadendal:
J Martin (028) 254 9463
or www.redcross.org.za

Commitment to local development and reducing poverty

The Greyton Branch of SARCS comprises of a core group of volunteers, plus others who can be called on in times of emergency. It works tirelessly to try to reduce poverty in Theewaterskloof, working closely with local government as well as community and church leaders. The Red Cross has also initiated support groups for orphans, vulnerable children and their guardians, as well as youth programmes, women's development programmes and peer education programmes. From a small beginning, the organisation has expanded into the neighbouring villages of Genadendal, Bereaville and Voorstekraal, as well as serving the surrounding farms.

Figure 6.5.1 Volunteers delivering soup during the November 2008 floods

A first responder in times of emergency

The Red Cross in Greyton responds to local emergencies of all kinds and sizes. They are often the first to respond to a medical emergency as there is no local ambulance service. Volunteers also provide social relief in times of emergency, when the municipality and the police are stretched to their limits.

During the devastating floods in the Overberg in November 2008, SARCS provided hot soup and bread for approximately 300 people over three days. Red Cross volunteers also provided blankets and dry clothes, especially for the elderly. This flood experience provided the main impetus for developing a more structured response to disasters. They now officially provide social relief in the region, supplying food parcels and blankets when required.

All funds are raised by the branch itself, and in 2006 the Red Cross purchased a small government house in Heuwelkroon with funds donated by the local senior citizens' organisation. The branch has since renovated the building to provide a small office, plus space for meetings or training, and storage for first aid and disaster equipment. They have also planted a vegetable garden to provide fresh produce for food parcels.

Figure 6.5.2 Greyton Red Cross headquarters

Did you know?

- Genadendal residents initiated a community clean up of the river running through the town. They saw that accumulated litter and debris worsen flooding during the rainy season by blocking storm-water drains and can even change the river's course, with disastrous results
- The Greyton/Genadendal Branch of the SARCS has purchased a vehicle for emergency patient transport, equipped with a trolley bed, defibrillator, drip stand and other essential equipment
- The branch had already carried out assessments of the area's health and social needs before the 2008 flood event. This proved invaluable when it came to assisting the most vulnerable community members when the floods occurred

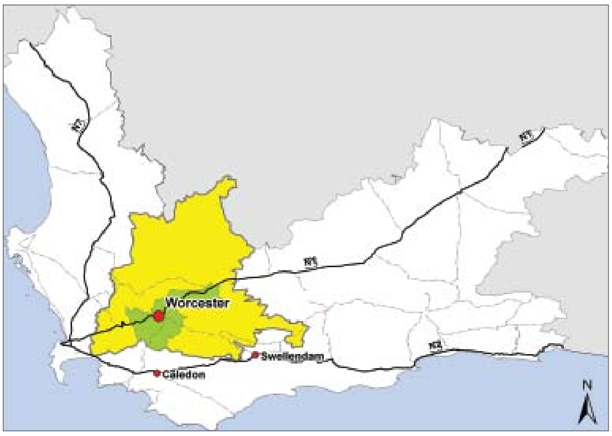
6.6 Strategic risk management planning

Breede Valley Fire & Rescue/Disaster Management Department

The Disaster Management Act requires municipalities to take greater responsibility for their own risk management. This often implies new institutional capacity and substantially upgraded skilled human resources. It also requires senior management and council support – often accompanied by financial resources.

This example, of the Breede Valley Fire and Emergency Services, shows how a previously under-resourced emergency service can be turned around as a result of focused and enthusiastic leadership. It not only highlights the importance of frank, critical review and internal redress to maximise returns on council investments, it also shows how new skills and capacity can enhance staff confidence and increase public confidence in the service.

Map 6.6.1 Location of Worcester



For more information on the Breede Valley Fire and Emergency Services:

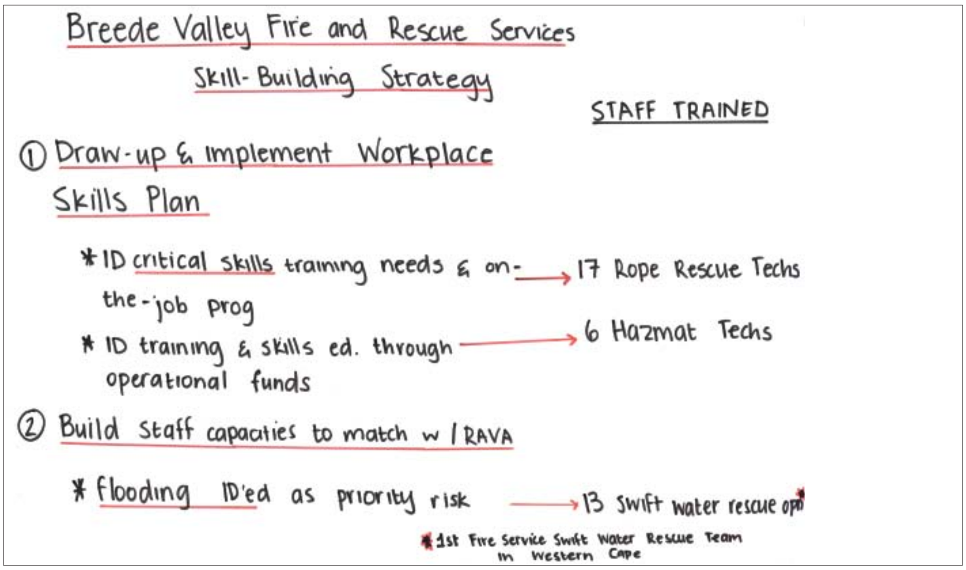
P Govender pgovender@breedevallei.gov.za or (023) 342 2430

Revamping the service – vision, internal skills audit and focused retraining

In 2005, the Breede Valley Municipality's newly appointed fire chief carried out an internal skills audit. This revealed that most of the fire fighters were ill-equipped to deal with the demands of a modern fire service. Using a 'back-to-basics' approach, all personnel were then re-trained to create new memory and capacities that would then provide the foundation for additional specialised training.

Figure 6.6.1 Swift Water Rescue Operations: fire-fighters in action during the November 2008 floods

Flipchart 6.6.1 Breede Valley Fire and Rescue Services: Skill-building strategy



Skilled responders make a difference

During the November 2008 floods, the Hex River Valley town of Touws River was divided into three parts by floodwaters, isolating between 2 000 and 3 000 people. The Swift Water Rescue capacity was called into action, rescuing five people from the Touws River in a period of just two hours. The Swift Water Rescue team was also critical in ferrying basic provisions to isolated communities across the Donkies River.

Finding funds: solid motivation, supportive council

The Breede Valley Municipal Council has been the main source of financial support for upgrading the service. This was motivated by a detailed situational analysis, report and a budget being granted to overhaul the department. In the first six months, almost R500,000 was spent on upgrading facilities and undertaking renovations.

One critical resource that had never existed before is a new repeater with VHF frequency that has already been installed in a Repeater High Site. This, for the first time, provides the whole Breede Valley area with emergency radio communication.

Did you know?

- The Breede Valley Fire & Rescue/Disaster Management decided to reduce the number of wildfires by working more closely with farmers to remove overgrown vegetation
- Operational fire fighters have been taught how to facilitate fire and life safety education for pre-primary and primary school children
- Twenty-four residents from the Zwelethemba, De Doorns and Avian Park informal settlements have been trained in a three-day basic fire awareness course

To sum up...

- The South African Disaster Management Framework recognises the critical role of civil society in reducing risk
- Section 1.3.2.2 of the Framework describes the community as "the coalface of disaster risk management" because "when disasters occur or are threatening to occur, the initial response to the event comes from those directly affected by it". It therefore calls for community participation in disaster risk management to be "actively promoted and encouraged, particularly in communities at risk"[21]
- The selection of case studies in this chapter illustrates how local agency across the Western Cape is already making valuable contributions to locally appropriate disaster risk reduction
- The expertise, dedication and time volunteered by local community groups and enterprising individuals are providing invaluable support and information to disaster management officials
- It is important to continue to harness the skills of the local community, for the benefit of local at-risk communities and to inform official response and effective risk reduction strategies

Chapter 7

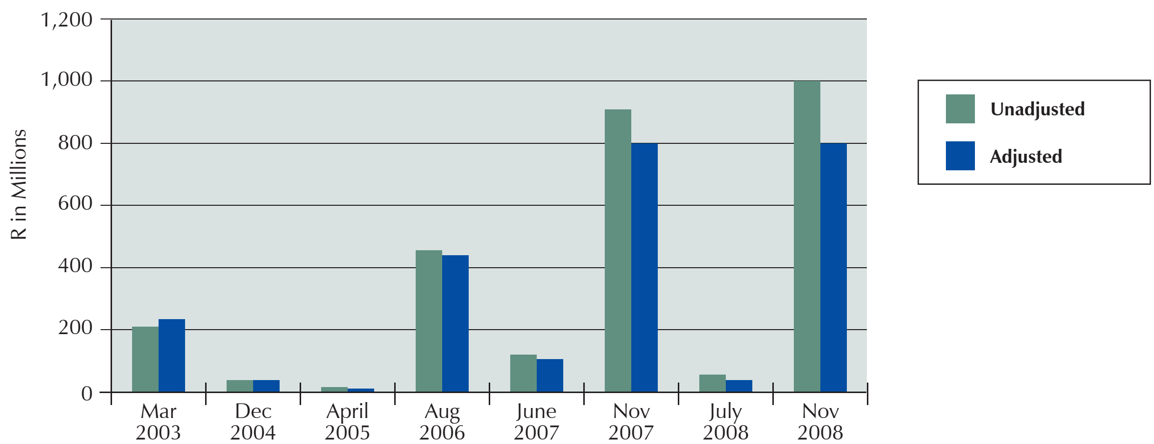
From counting costs to protective planning

Historically, in South Africa, post-disaster loss assessment has informed relief, recovery and reconstruction. This 'counting of costs' is regarded as a key step in establishing the severity of a disaster occurrence – and for determining whether it is officially classified as a local, provincial or national disaster.

The costing of losses also informs submissions for financial support, and subsequent requests to the National Treasury for recovery assistance. However, these are not the only reasons for costing losses after severe storms and floods.

This chapter summarises the direct damage costs (which exceed R2.5 billion) associated with eight cut-off lows that occurred in the Western Cape from between 2003 to 2008. It systematically presents direct damage costs sustained by national and provincial departments as well as municipalities over this period. It also spatially consolidates 'ring-fenced' or aggregate loss information for the public sector and farming community into totals for specific municipalities.

The chapter shows that there are specific high-risk areas that are sustaining repeated knocks from a combination of severe weather and flood exposure. It also illustrates that there is a rising loss trajectory for severe storms, even when reported damage costs are adjusted for inflation. It is clear from this that there are costly developmental consequences to reacting to climate risks such as cut-off low systems 'after the fact', rather than managing them proactively and strategically.



This graph shows direct damage costs in the Western Cape associated with cut-off low weather systems. It compares damage costs before adjustments for inflation with those that have been inflation-adjusted to 2005 values. The sizeable losses (in 2003, 2006, 2007 and 2008) reflect particularly severe 'transboundary' events that affected more than one district municipality.

7.1 Introducing the chapter

7.1.1 What does the National Disaster Management Framework (NDMF) specify?

The NDMF clearly spells out the importance of post-disaster reviews for improving risk-management in disaster-prone areas. It states:

'Comprehensive reviews must be conducted routinely after all significant events and events classified as disasters…The findings will directly influence the review and updating of disaster risk management plans and will also serve as valuable training aids'[22]

7.1.2 Why is post-disaster research on 'realised risks' important for development planning?

Disaster events represent 'realised risks', in which previously identified flood risks, for example, unfold into real and identifiable flood events. These occurrences can be clearly defined by their times and dates, as well as by their respective locations, magnitude and effects. Studies done of these events are often known as '*ex-post*' (or 'post-disaster') research, and are particularly useful for identifying areas and production activities and services that resisted or failed in the face of a severe weather shock. They also help provide reasons that particular communities, areas or infrastructure may be affected differently. This can improve development planning and focus risk management efforts.

In addition, research results can assist in understanding the sequencing of intensifying conditions. This applies to both the progression of vulnerability in communities exposed to severe weather and endangering floods, and the knock-on effects of endangering natural processes.

One illustration of this is when heavy rainfall over mountainous areas leads to flash-flooding of rivers in areas where farming activities have extended right to the edges of the river channel itself. In this example, farming in the riparian zone not only increases the farmer's own flood vulnerability (especially if valuable pumping equipment or other farm infrastructure has been sited right next to the river) but might also increase the magnitude of flooding downstream.

The loss analysis in *RADAR* begins to indicate the costs of poor climate risk management in the Western Cape. It does this by consolidating direct damage costs for defined severe weather events and drawing attention to particular sectors and municipalities that are repeatedly affected, and areas where focused climate risk management should constitute an urgent planning priority.

7.1.3 What does this loss analysis include?

The losses reported in *RADAR* refer to direct damage estimates primarily provided by governmental and parastatal entities. Private farm loss estimates were also consolidated by the Provincial Department of Agriculture.

In order to smooth damage estimates for inflation over the six-year period, all economic losses were adjusted to 2005 values. The adjustment factors applied in the analysis are listed in Section 7.9.3.

7.1.4 What does this loss analysis leave out?

This analysis excludes private sector losses (except reported farm impacts), especially those borne by the insurance industry, in part to avoid double-counting of damage records. It also omits indirect and intangible losses with respect to impacts on livelihood impacts and lost production, as well as longer-term macro-economic impacts.

7.1.5 Can aggregate flood damage costs recorded within municipalities be applied at household level?

The economic impact of severe weather events and endangering floods is not only reflected in the 'summing up' of losses. An event's proportionate impact also differs depending on the robustness of the local economy and households affected. It is also determined by the extent to which the communities have been able to diversify (i.e. to spread risk across activities, sectors and services).

Table 7.1.5.1 illustrates the relative differences in impact of the November 2008 cut-off low across the 13 municipalities affected. This relates consolidated damage costs incurred in each municipality to annual household income in the municipalities. It shows that the proportionate loss per household in Swellendam was approximately R35,000 – or 76% of the average annual household income estimated for all households in the municipality at that time (R46,000), based on 2001 Census data.

As it is clear that household incomes have shifted since 2001, this value may be an over-estimate. However, it does indicate the severe developmental consequences of weather shocks and flood losses, especially in agriculturally-dependent areas. This is particularly the case in the smaller and more poorly resourced municipalities that are repeatedly affected – especially those that are also affected by drought and severe wildfires.

Table 7.1.5.1 Example of how consolidated damage costs of severe weather/flooding in the November 2008 cut-off low could be expressed as a % of average annual household income (2005 values)

Municipality	Direct damage cost (R)	Number of households	Direct damage cost per household (R)	Annual household income (R)	Direct damage cost as a % of household income
Breede Valley	194,830,727	36,495	5,339	52,748	10.12
Langeberg	80,792,587	21,856	3,697	42,320	8.73
Cape Agulhas	8,601,336	7,615	1,130	60,826	1.86
Cape Winelands	2,627,261	2,559	1,027	37,893	2.71
Drakenstein	998,032	51,614	19	63,503	0.03
George	2,541,129	42,793	59	36,102	0.16
Hessequa	33,814,648	12,481	2,709	52,273	5.18
Mossel Bay	2,383,500	28,349	84	65,711	0.13
Oudtshoorn	1,929,841	17,913	108	48,620	0.22
Overstrand	9,752,488	21,953	444	62,542	0.71
Swellendam	244,249,621	6,958	35,103	46,070	76.19
Theewaterskloof	176,381,059	23,464	7,517	46,572	16.14
Witzenberg	35,765,436	24,410	1,465	40,839	3.59
Total	**794,667,664**	**298,460**	**2,663**	**656,024**	**0.41%**

7.2 Summary of all direct damage reported from cut-off lows

Table 7.2.1 Summary of direct damage from cut-off lows (2005 values)

Department/ Municipality	Direct Damage Cost (R)			
	Mar 2003	Dec 2004	April 2005	Aug 2006
National Departments and Parastatals				
DWA	15,534,160	0	0	2,694,069
SANParks	0	0	0	1,689,660
SANRAL	0	0	0	82,356,186
Transnet	0	0	0	44,350,421
Eskom	1,794,560	0	0	0
Telkom	0	0	0	628,986
Nat. Dept & Parastatals Total	17,328,720	0	0	131,719,321
Provincial Departments				
Agriculture	100,513,458	25,832,800	0	103,138,057
CapeNature	1,267,408	0	0	3,191,580
Education	1,915,693	0	0	2,464,088
Emergency Services	112,160	0	0	0
Housing	0	0	3,393,346	27,114,993
Provincial Roads	88,140,039	9,911,360	0	85,271,508
Public Works	0	0	0	12,165,552
Social Dev.	1,736,237	0	0	0
Prov. Dept. Total	193,684,994	35,744,160	3,393,346	233,345,777
District & Local Municipalities				
West Coast District				
Bergrivier	0	0	0	0
Cederberg	0	0	0	0
Matzikama	0	0	0	0
Saldanha Bay	0	0	0	0
Swartland	0	0	0	0
Subtotal	0	0	0	0
Cape Winelands District				
Langeberg	1,436,786	0	0	1,339,055
Breede Valley	0	0	0	0
Cape Winelands DMA	0	1,265,280	0	0
Stellenbosch	0	0	0	0
Subtotal	1,436,786	1,265,280	0	1,339,055
Overberg District				
Cape Agulhas	0	0	5,457,215	0
Overberg DMA	0	3,194,832	0	0
Overstrand	0	0	0	0
Swellendam	1,299,934	0	0	3,914,379
Theewaterskloof	0	0	0	0
Subtotal	1,299,934	3,194,832	5,457,215	3,914,379
Eden District				
Bitou	0	0	0	823,401
Eden DMA	200,206	8,364,676	0	5,414,791
George	1,233,760	337,408	0	15,668,322
Hessequa	2,772,595	6,853,600	0	17,835,300
Kannaland	569,212	0	0	0
Knysna	251,028	2,108,800	0	30,975,570
Mossel Bay	0	0	0	14,510,729
Oudtshoorn	0	0	0	6,546,494
Subtotal	5,026,800	17,664,484	0	91,774,607
Central Karoo District				
Prince Albert	0	0	0	358,583
Subtotal	0	0	0	358,583
Municipality Total	7,763,521	22,124,596	5,457,215	97,386,625
Private Sector				
Bellair Dam	15,702,400	0	0	0
Insurance Agency	3,590,802	0	0	16,725,994
Irrigation Boards	182,821	0	0	0
Private Sectors Total	**19,476,023**	**0**	**0**	**16,725,994**
Event Total	**238,253,259**	**57,868,756**	**8,850,561**	**479,177,717**

in the Western Cape, 2003–2008 (2005 values)

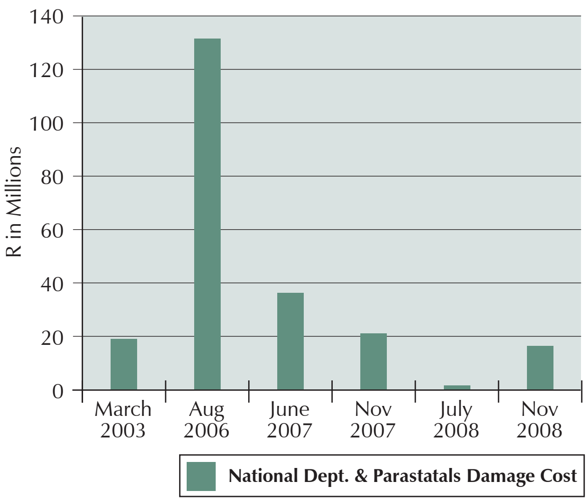
Direct Damage Cost (R)				
Jun 2007	**Nov 2007**	**Jul 2008**	**Nov 2008**	**Total**
National Departments and Parastatals				
911,085	6,299,502	2,383,500	12,910,625	40,732,941
0	10,238,860	0	0	11,928,520
107,722	0	174,988	1,378,458	84,017,352
30,369,500	4,338,500	0	0	79,058,421
3,297,260	0	0	0	5,091,820
120,543	0	0	0	749,529
34,806,110	20,876,862	2,558,488	14,289,083	221,578,584
Provincial Departments				
24,170,504	111,550,862	21,573,563	631,939,274	1,018,718,518
0	6,975,857	0	0	11,434,845
447,169	0	0	0	4,826,949
0	0	0	0	112,160
0	69,444,900	218,488	0	100,171,727
8,107,411	319,593,746	14,856,832	94,843,239	620,724,135
0	0	0	0	12,165,552
356,625	0	0	0	2,092,862
33,081,709	507,565,365	36,648,883	726,782,513	1,770,246,747
District & Local Municipalities				
West Coast District				
12,797,556	0	122,170	0	12,919,727
22,701,722	0	13,021,855	0	35,723,577
3,895,973	0	3,260,628	0	7,156,601
1,266,842	0	0	0	1,266,842
2,778,472	0	1,344,498	0	4,122,970
43,440,565	0	17,749,151	0	61,189,717
Cape Winelands District				
0	59,045	0	10,979,978	13,814,865
0	0	0	4,984,931	4,984,931
0	0	0	202,168	1,467,448
0	183,812	0	0	183,812
0	242,857	0	16,167,078	20,451,056
Overberg District				
0	0	0	5,203,975	10,661,190
0	0	0	0	3,194,832
0	0	0	599,848	599,848
0	11,518,718	0	27,684,448	44,417,479
0	9,369,806	0	2,462,950	11,832,756
0	20,888,524	0	35,951,220	70,706,105
Eden District				
0	30,195,960	0	0	31,019,361
0	35,940,134	0	0	49,919,807
0	41,735,223	0	0	58,974,713
0	28,616,746	0	1,477,770	57,556,011
0	8,677,000	0	0	9,246,212
0	60,935,000	0	0	94,270,397
0	35,988,725	0	0	50,499,455
0	1,860,783	0	0	8,407,276
0	243,949,570	0	1,477,770	359,893,232
Central Karoo District				
0	0	0	0	358,583
0	0	0	0	358,583
43,440,565	265,080,951	17,749,151	53,596,068	512,598,693
Private Sector				
0	0	0	0	15,702,400
0	0	0	0	20,316,797
0	0	0	0	182,821
0	**0**	**0**	**0**	**36,202,017**
111,328,385	**793,523,178**	**56,956,522**	**794,667,663**	**2,540,626,042**

7.3 Direct damage costs reported by national departments and parastatals

Table 7.3.1 Direct damage costs reported from cut-off lows in the Western Cape from 2003–2008 (2005 values)

Nat. Dept. & Parastatals	Direct Damage Cost (R)							As % of Nat. Dept. & Parastatals
	March 2003	Aug 2006	June 2007	Nov 2007	July 2008	Nov 2008	Total	
DWA	15,534,160	2,694,069	911,085	6,299,502	2,383,500	12,910,625	40,732,941	18.4
SANParks	0	1,689,660	0	10,238,860	0	0	11,928,520	5.4
SANRAL	0	82,356,186	107,722	0	174,988	1,378,458	84,017,354	37.9
Transnet	0	44,350,421	30,369,500	4,338,500	0	0	79,058,421	35.7
Eskom	1,794,560	0	3,297,260	0	0	0	5,091,820	2.3
Telkom	0	628,986	120,543	0	0	0	749,529	0.3
Total	**17,328,720**	**131,719,322**	**34,806,110**	**20,876,862**	**2,558,488**	**14,289,083**	**221,578,585**	**100.0**
As % of event total	**7.27**	**27.49**	**31.26**	**2.63**	**4.49**	**1.80**		

Graph 7.3.1 Damage costs reported by national departments and parastatals from 2003 to 2008



Graph 7.3.2 Individual national department's and parastatals loss as a percentage of the total national direct damage

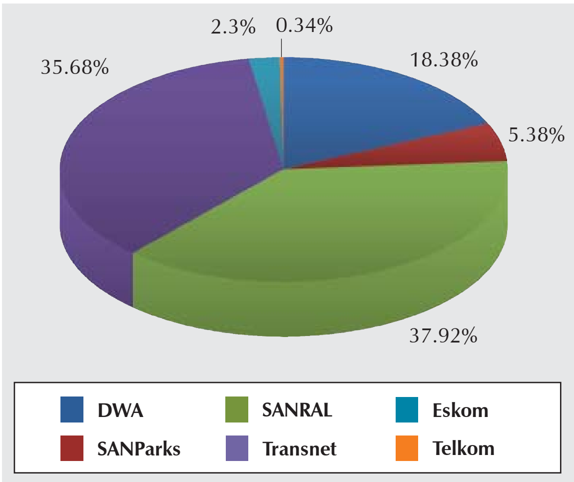


Table 7.3.2 Repeat damage costs reported by the Department of Water Affairs (DWA) gauging stations in severe weather events, 2003, 2006 and 2007 (2005 values)

Municipality	Gauging Station No.	Location	Direct Damage Cost (R)			
			Mar 2003	Aug 2006	Nov 2007	Total
George	K3H004	Malgas River at Blanco	56,080	28,161	52,062	136,303
George	K4H003		112,160	28,161	21,693	162,014
George	K4H003	Diep River at Woodville Forest Reserve	84,120	46,935	21,693	152,748
Mossel Bay	K1H005	Moordkuil River at Banff	448,640	28,161	142,303	619,104
Mossel Bay	K2H002	Great Brak River at Wolvedans	56,080	56,322	32,973	145,375
Oudtshoorn	J3H015	Little Le Roux River at De Kombuys	56,080	28,161	26,031	110,272
Kannaland	J2H007	Huis River at Zoar	112,160	18,774	20,825	151,759
Kannaland	J1H017	Sand River at Buffelsfontein	841,200	14,081	6,942	862,222
Kannaland	J1H018	Touws River at Okkerskraal	1,402,000	18,774	78,093	1,498,867
Hessequa	H8H001	Duiwenhoks River at Dassjesklip	336,480	46,935	164,863	548,278
Hessequa	H8H003	Duiwenhoks River at Kliphoogte	2,243,200	18,774	117,140	2,379,114
Knysna	K4H002	Karatara River at Karatara Forst Reserve	89,728	46,935	17,354	154,017
Knysna	K5H003		78,512	704,025	124,949	907,486
Knysna	K5H002	Knysna River at Milwood Forest Reserve	78,512	469,350	73,755	621,617
Total			5,994,952	1,553,549	900,673	**8,449,173**

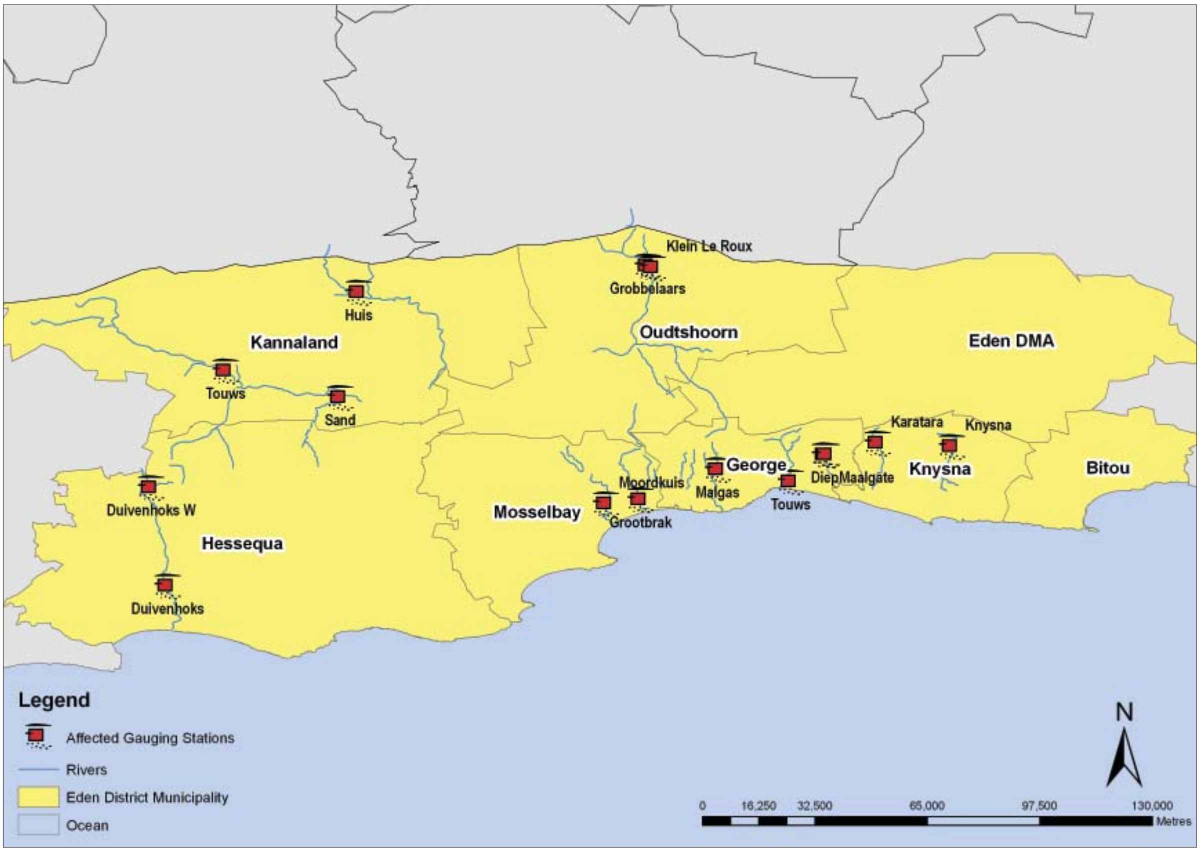
Damage costs for national departments and parastatals – what do the tables show?

Table 7.3.1 shows that the total damage costs sustained by national departments and parastatals over eight severe weather events exceeded R221 million. Of the four national entities reported here, South African National Roads Agency Limited (SANRAL) incurred R84 million, or 37.92% of total damage costs. These losses were attributed primarily to the severe damage to the N2 along the Kaaimans Pass between George and Knysna due to the August 2006 cut-off lows.

The Department of Water Affairs (DWA) also sustained repeat flood damage, with R40.73 million in repair costs, primarily from damage sustained to its network of river gauging stations across the Southern Cape and the Overberg. Table 7.3.2 shows that from 2003–2007, 14 gauging stations were repeatedly damaged, with costs exceeding R8.4 million.

Map 7.3.1, which shows the location of the high-risk gauging stations, also indicates areas, sectors and services that are significantly flood-exposed. This is because high-magnitude floods that wash away gauging stations usually have 'knock-on' consequences for roads, bridges, sewage and water treatment infrastructure, as well as farming activities, along the flood-affected rivers. The map illustrates the value of spatially representing damaged infrastructure (i.e. the failed gauging stations) for future spatial development, infrastructure and contingency planning in flood and storm-exposed areas.

Map 7.3.1 Recurring impacts from DWA – March 2003, August 2006 and November 2007

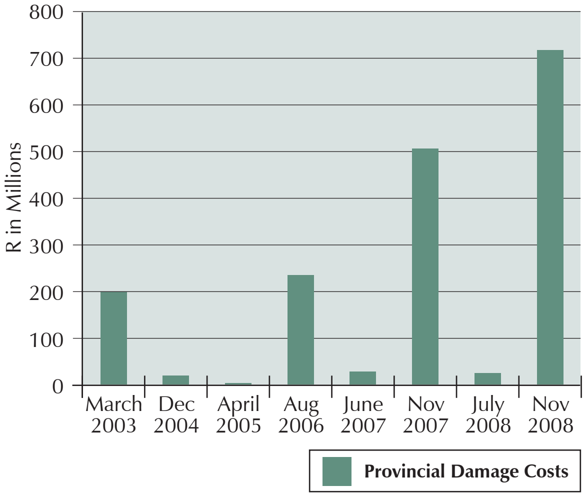


7.4 Direct damage costs to provincial departments

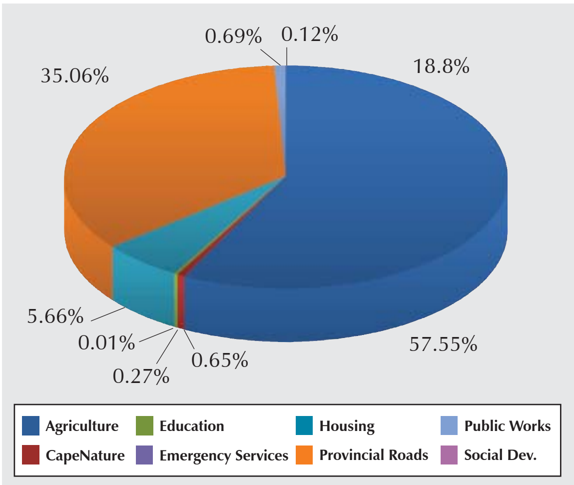
Table 7.4.1 Direct damage costs to provincial departments, as reported from cut-off lows in the Western Cape 2003–2008 (2005 values)

Prov. Depts.	Direct Damage Cost (R)									% all Nat. Dept. & SOE
	March 2003	Dec 2004	April 2005	Aug 2006	June 2007	Nov 2007	July 2008	Nov 2008	Total	
Agriculture	100,513,458	25,832,800	0	103,138,057	24,170,504	111,550,862	21,573,563	631,939,273	1,018,718,517	57.5
Cape-Nature	1,267,408	0	0	3,191,580	0	6,975,856	0	0	11,434,844	0.6
Education	1,915,692	0	0	2,464,087	447,169	0	0	0	4,826,948	0.3
Emergency Services	112,160	0	0	0	0	0	0	0	112,160	0.01
Housing	0	0	3,393,346	27,114,993	0	69,444,900	218,487	0	100,171,726	5.7
Provincial Roads	88,140,038	9,911,360	0	85,271,508	8,107,411	319,593,745	14,856,832	94,843,239	620,724,133	35.1
Public Works	0	0	0	12,165,552	0	0	0	0	12,165,552	0.7
Social Dev.	1,736,236	0	0	0	356,625	0	0	0	2,092,861	0.1
Prov. Depts. Total	193,684,992	35,744,160	3,393,346	233,345,777	33,081,709	507,565,363	36,648,882	726,782,512	1,770,246,740	100.0
As % of Event Total	**81.29**	**61.77**	**38.34**	**48.70**	**29.72**	**63.96**	**64.35**	**91.46**	**69.68**	

Graph 7.4.1 Damage cost reported by provincial departments, 2003–2008



Graph 7.4.2 Individual provincial department's loss as a percentage of the total provincial direct damage



Direct damage costs for provincial departments – what does the table show?

The data indicate significant costs for provincial departments over the eight severe weather events, totalling R1.8 billion from 2003 to 2008. This constitutes 69.7% of all reported damage costs for severe storms over this period, and reflects markedly rising costs, particularly for the agricultural sector.

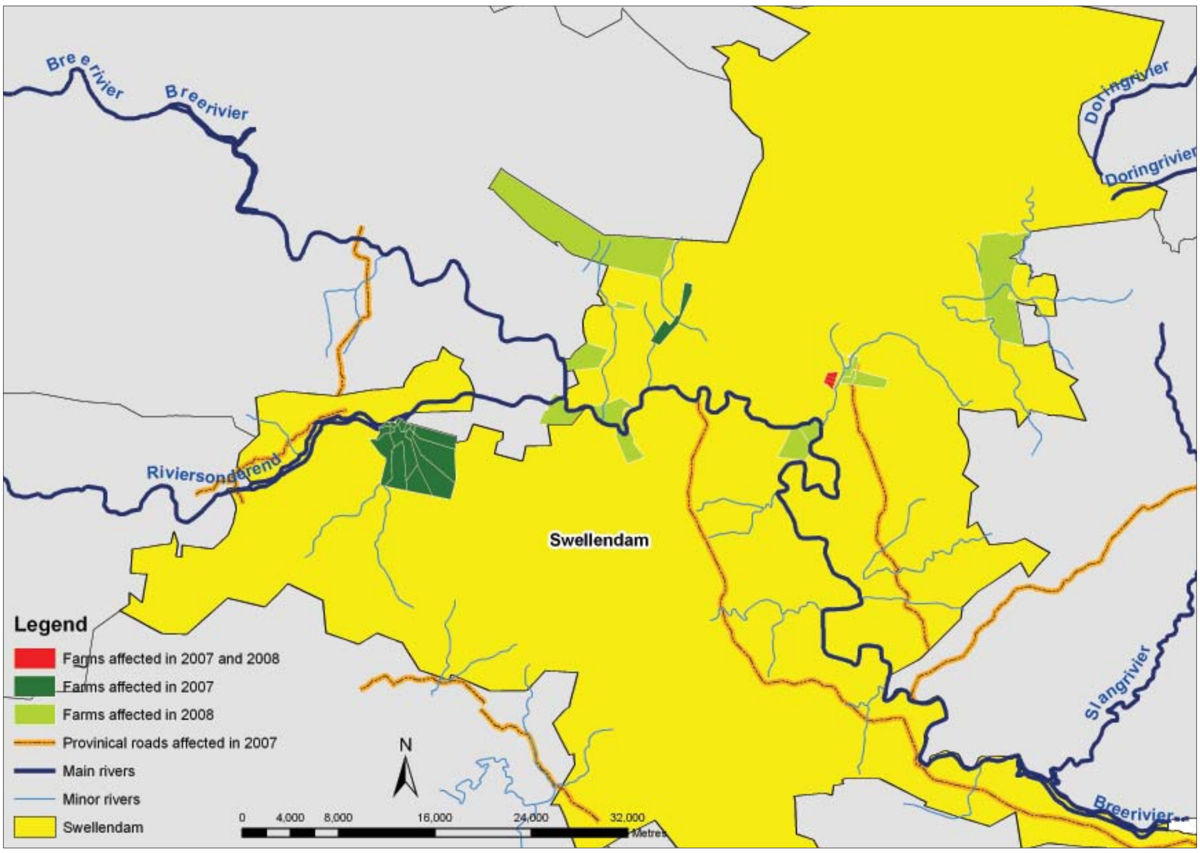
The two departments reporting the highest damage costs were the Department of Agriculture and Department of Provincial Roads. These account for 58% and 35% of total damage costs respectively, with farm losses rising steadily from R100.5 million in the 'Montagu floods' event of 2003 to R631.9 million as a result of the November 2008 cut-off low.

The Provincial Department of Housing has also come under pressure, with low-cost housing damage incurred almost annually, and totalling more than R100 million.

However, these figures do not include public infrastructure or farms that have sustained repeat damage costs over the eight year period, largely due to limited capacity of some provincial departments to map or 'geo-reference' the damaged infrastructure. In addition, agricultural damage costs reported by the Provincial Department of Agriculture include modest departmental losses as well as those reported by commercial farmers.

Map 7.4.1 illustrates the usefulness of spatial data by showing the location of some of the farms that reported damage in the November 2007 and 2008 cut-off lows, along with provincial roads affected by the same events. This enables partial mapping of high-risk rural locations, where access is limited by flooded roads and damaged bridges. It also illustrates the value of post-impact mapping for future integrated risk management and spatial development planning.

Map 7.4.1 Farms that reported damage in Swellendam Municipality in the November 2007 and 2008 cut-off lows, along with provincial roads affected in November 2007



7.5 Direct damage costs reported by district and local municipalities

Table 7.5.1 Direct damage costs reported by district and local municipalities from cut-off lows in the Western Cape from 2003–2008 (2005 values)

Munici-pality	Direct Damage Cost (R)									% of Mun.
	March 2003	Dec 2004	April 2005	Aug 2006	June 2007	Nov 2007	July 2008	Nov 2008	Total	
West Coast District										
Bergrivier	0	0	0	0	12,797,556	0	122,170	0	12,919,727	2.5
Cederberg	0	0	0	0	22,701,722	0	13,021,855	0	35,723,577	7.0
Matzikama	0	0	0	0	3,895,973	0	3,260,628	0	7,156,601	1.4
Saldanha Bay	0	0	0	0	1,266,842	0	0	0	1,266,842	0.2
Swartland	0	0	0	0	2,778,472	0	1,344,498	0	4,122,970	0.8
Subtotal	0	0	0	0	43,440,565	0	17,749,151	0	61,189,717	11.9
Cape Winelands District										
Langeberg	1,436,786	0	0	1,339,055	0	59,045	0	10,979,978	13,814,865	2.7
Breede Valley	0	0	0	0	0	0	0	4,984,931	4,984,931	1.0
Cape Winelands DMA	0	1,265,280	0	0	0	0	0	202,168	1,467,448	0.3
Stellenbosch	0	0	0	0	0	183,812	0	0	183,812	0.04
Subtotal	1,436,786	1,265,280	0	1,339,055	0	242,857	0	16,167,078	20,451,056	4.0
Overberg District										
Cape Agulhas	0	0	5,457,215	0	0	0	0	5,203,975	10,661,190	2.1
Overberg DMA	0	3,194,832	0	0	0	0	0	0	3,194,832	0.6
Overstrand	0	0	0	0	0	0	0	599,848	599,848	0.1
Swellendam	1,299,934	0	0	3,914,379	0	11,518,718	0	27,684,448	44,417,479	8.7
Theewaterskloof	0	0	0	0	0	9,369,806	0	2,462,950	11,832,756	2.3
Subtotal	1,299,934	3,194,832	5,457,215	3,914,379	0	20,888,524	0	35,951,220	70,706,105	13.8
Eden District										
Bitou	0	0	0	823,401	0	30,195,960	0	0	31,019,361	6.1
Eden DMA	200,206	8,364,676	0	5,414,791	0	35,940,134	0	0	49,919,807	9.7
George	1,233,760	337,408	0	15,668,322	0	41,735,223	0	0	58,974,713	11.5
Hessequa	2,772,595	6,853,600	0	17,835,300	0	28,616,746	0	1,477,770	57,556,011	11.2
Kannaland	569,212	0	0	0	0	8,677,000	0	0	9,246,212	1.8
Knysna	251,028	2,108,800	0	30,975,570	0	60,935,000	0	0	94,270,397	18.4
Mossel Bay	0	0	0	14,510,729	0	35,988,725	0	0	50,499,455	9.9
Oudtshoorn	0	0	0	6,546,494	0	1,860,783	0	0	8,407,276	1.6
Subtotal	5,026,800	17,664,484	0	91,774,607	0	243,949,570	0	1,477,770	359,893,232	70.2
Central Karoo District										
Prince Albert	0	0	0	358,583	0	0	0	0	358,583	0.1
Subtotal	0	0	0	358,583	0	0	0	0	358,583	0.1
Municipality Total	7,763,521	22,124,596	5,457,215	97,386,625	43,440,565	265,080,951	17,749,151	53,596,068	512,598,693	100.0
% of Event Total	**3.26%**	**38.23%**	**61.66%**	**20.32%**	**39.02%**	**33.41%**	**31.16%**	**6.74%**	**20.18%**	

Damage costs for local and district municipalities – what does the table show?

Costs reported here are those consolidated by local and district municipalities – often by disaster managers and municipal engineers. They show total municipal repair costs of R513 million over the eight severe weather events, with almost R360 million (70%) incurred in the Eden District alone.

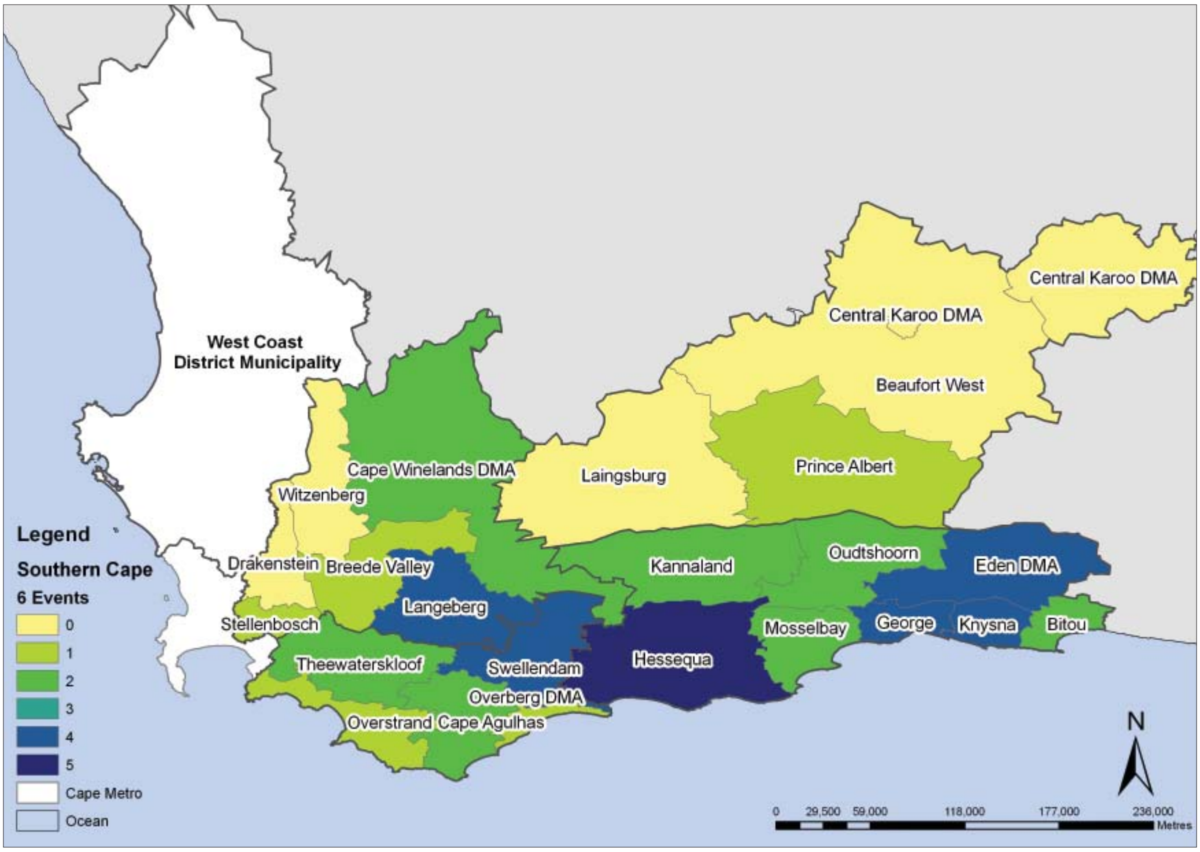
Overall, the most expensive severe weather event for municipalities was the November 2007 cut-off low. This storm led to R265 million in direct costs to municipalities, and was responsible for around 51% of all municipal costs over the eight events. From 2003 to 2008, Knysna reported the most significant flood damage costs – R94 million over the eight events, and approximately 18% of total municipal damage.

Unsurprisingly, other Southern Cape municipalities have also sustained repeat 'knocks'. George, Hessequa and Mossel Bay each reported more than R50 million in weather and flood-related losses. In the Overberg, Swellendam was repeatedly at risk, having sustained direct losses in excess of R44 million during four cut-off lows.

Map 7.5.1 shows the municipalities most vulnerable to repeat cut-off low-related municipal damage in the Southern Cape. The map reveals that Hessequa was affected most frequently, sustaining municipal impacts in five of the six cut-off low events.

Most municipal costs were due to storm- and flood-damaged roads and stormwater infrastructure. In 2006, this was responsible for 53% of all municipal damage reported in Eden in 2006, followed by damage to sewage and water treatment facilities. Research findings also indicate that the risk of flood damage increased where there was limited investment in stormwater systems and routine maintenance. Municipal flood damage was also worse when litter and vegetative debris block drains and where there had been rapid urban expansion. This resulted in hardened catchments, as did draining or degrading of protective wetlands.

Map 7.5.1 Municipalities most vulnerable to repeat cut-off low-related municipal damage in the Southern Cape



7.6 November 2007: Cut-off low damage costs aggregated or 'ring fenced'

Table 7.6.1 Step 1: Consolidated national, provincial and municipal damage costs (2005 values)

Munici-pality	Direct Damage Cost (R)									As % of Event Total
	DWA	SAN-Parks	Trans-net	Agri-culture	Provincial Roads	Housing	Cape-Nature	Municipal	Total	
Beaufort West	0	0	0	438,865	1,396,129	0	0	0	1,834,994	0.2
Bitou	1,604,377	0	0	185,080	0	16,569,140	776,140	30,195,960	49,330,698	6.2
Breede Valley	203,910	8,503,460	0	885,054	303,695	0	0	0	9,896,119	1.2
Cape Agulhas	0	0	0	0	0	0	5,631,373	0	5,631,373	0.7
Cape Wine-lands DMA	0	0	0	0	2,603,100	0	0	0	2,603,100	0.3
Central Karoo DMA	0	0	0	0	86,770	0	0	0	86,770	0.01
Drakenstein	59,871	0	0		117,140	0	0	0	177,011	0.02
Eden DMA	0	0	0	38,392,927	76,179,722	0	0	35,940,134	150,512,783	19.0
George	215,190	0	0	20,579,289	86,632,122	35,365,122	316,711	41,735,223	184,843,656	23.3
Hessequa	507,605	0	0	1,010,357	52,951,097	0	0	28,616,746	83,085,805	10.5
Kannaland	283,738	0	0	2,481,668	0	8,956,612	0	8,677,000	20,399,018	2.6
Knysna	305,430	1,735,400	4,338,500	470,168	3,644,340	8,554,026	0	60,935,000	79,982,864	10.1
Laingburg	48,591	0	0	2,201,800	5,030,057	0	0	0	7,280,448	0.9
Langeberg	90,241	0	0	389,181	8,904,771	0	0	59,045	9,443,238	1.2
Mossel Bay	1,921,956	0	0	4,610,414	0	0	0	35,988,725	42,521,095	5.4
Oudtshoorn	780,062	0	0	22,803,450	70,980,116	0	251,633	1,860,783	96,676,044	12.2
Overberg DMA	0	0	0		8,329,920	0	0	0	8,329,920	1.0
Prince Albert	0	0	0		48,591	0	0	0	48,591	0.01
Stellenbosch	165,731	0	0		0	0	0	183,812	349,543	0.04
Swellendam	112,801	0	0	1,476,635	997,855	0	0	11,518,718	14,106,009	1.8
Theewaters-kloof	0	0	0	15,625,975	780,930	0	0	9,369,806	25,776,711	3.2
Witzenberg	0	0	0		607,390	0	0	0	607,390	0.1
Total	**6,299,502**	**10,238,860**	**4,338,500**	**111,550,863**	**319,593,746**	**69,444,900**	**6,975,857**	**265,080,951**	**793,523,179**	**100.0**

Table 7.6.2 Step 2: Consolidated damage costs per capita for each municipality for the November 2007 cut-off low (2005 values)

Municipality	Total Direct Damage Cost (R)	Population (2007)	Per Capita Direct Damage Cost (R)
Beaufort West	1,834,994	37,090	49
Bitou	49,330,698	39,002	1,265
Breede Valley	9,896,119	134,271	74
Cape Agulhas	5,631,373	28,444	198
Cape Winelands DMA	2,603,100	5,260	495
Central Karoo DMA	86,770	56,230	2
Drakenstein	177,011	217,089	1
Eden DMA	150,512,783	11,479	13,112
George	184,843,656	136,542	1,354
Hessequa	83,085,805	39,081	2,126
Kannaland	20,399,018	24,715	825
Knysna	79,982,864	65,045	1,230
Laingsburg	7,280,448	5,156	1,412
Langeberg	9,443,238	80,121	118
Mossel Bay	42,521,095	117,838	361
Oudtshoorn	96,676,044	79,606	1,214
Overberg DMA	8,329,920	244	
Prince Albert	48,591	74,547	1
Stellenbosch	349,543	8,374	42
Swellendam	14,106,009	22,833	618
Theewaterskloof	25,776,711	86,719	297
Witzenberg	607,390	75,148	8
Total	**793,523,179**	**1,344,834**	**590**

This analysis estimates direct losses per capita per municipality for the 2007 November cut-off low, and involves two steps.

Step 1 spatially consolidates direct damage costs for **national**, **provincial** and municipality affected by the November 2007 cut-off low (Table 7.6.1).

Step 2 then calculates consolidated damage costs **per capita** within each municipality for the November 2007 severe weather event (Table 7.6.2).

This indicates the total damage costs per person in each municipality affected by the November 2007 cut-off low and adjusts the severity of the event for population size.

November 2007: Cut-off low damage costs aggregated or 'ring-fenced' – what do the tables show?

Usually, after a severe storm, municipal and provincial disaster management centres consolidate verified losses so that these are matched with the appropriate organ of state. For instance, the costs for roads damaged by the same flood in the same municipality are classified differently, depending on whether the damaged roads are identified as 'national', 'provincial' or 'municipal'. Table 7.6.1 shows that when we consolidate all national, provincial and municipal losses spatially by municipality for the November 2007 cut-off low, five municipalities stood out. These were George, the Eden District Management Area (Eden DMA), Outdshoorn, Hessequa and Knysna.

However, infrastructure and agricultural risks increase as a result of population growth in areas exposed to severe weather and flooding. This is particularly the case if developmental risk management measures have not been prioritised in the past. Table 7.6.2 adjusts the first table's consolidated loss data for 2007 population size in each of the municipalities affected by the 2007 cut-off low. It shows the economic significance of the weather event to residents in the Eden DMA – and its relative impact per capita in smaller municipalities, such as Hessequa and Laingsburg, as well as George. It shows how the proportional impact is relatively greater when the losses are spread over a smaller population. For instance, that these losses were equal to R2,126 per person in Hessequa, or 57% higher than the to R1,354 per person in George – although the George area sustained higher costs overall.

7.7 November 2008: Cut-off low damage costs aggregated or 'ring-fenced' for individual municipalities

Table 7.7.1 Step 1: Consolidated national, provincial and municipal damage costs (2005 values)

Municipality	Direct Damage Cost (R)						As % of Event Total
	DWA	SANRAL	Agriculture	Provincial Roads	Municipal	Total	
Breede Valley	8,620,325	1,378,458	144,372,588	35,474,425	4,984,931	194,830,727	24.52
Cape Agulhas	0	0	3,397,361	0	5,203,975	8,601,336	1.08
Cape Winelands DMA	0	0		2,425,092	202,168	2,627,261	0.33
Drakenstein	0	0	600,782	397,250	0	998,032	0.13
George	0	0	59,588	2,481,541	0	2,541,129	0.32
Hessequa	0	0	7,667,653	24,669,225	1,477,770	33,814,648	4.26
Langeberg	158,900	0	54,597,934	15,055,775	10,979,978	80,792,587	10.17
Mossel Bay	2,383,500	0	0	0	0	2,383,500	0.30
Oudtshoorn	0	0	0	1,929,841	0	1,929,841	0.24
Overstrand	0	0	0	9,152,640	599,848	9,752,488	1.23
Swellendam	1,152,025	0	213,744,698	1,668,450	27,684,448	244,249,621	30.74
Theewaterskloof	595,875	0	173,322,234	0	2,462,950	176,381,059	22.20
Witzenberg	0	0	34,176,436	1,589,000	0	35,765,436	4.50
Total	**12,910,625**	**1,378,458**	**631,939,274**	**94,843,239**	**53,596,068**	**794,667,664**	**100.00**

Table 7.7.2 Step 2: Consolidated damage costs per capita for each municipality for the November 2008 cut-off low (2005 values)

Municipality	Total Direct Damage Cost (R)	Population (2007)	Per Capita Direct Damage Cost (R)
Breede Valley	194,830,727	134,271	1,451
Cape Agulhas	8,601,336	28,444	302
Cape Winelands DMA	2,627,261	5,260	499
Drakenstein	998,032	217,089	5
George	2,541,129	136,542	19
Hessequa	33,814,648	39,081	865
Langeberg	80,792,587	80,121	1,008
Mossel Bay	2,383,500	117,838	20
Oudtshoorn	1,929,841	79,606	24
Overstrand	9,752,488	74,547	131
Swellendam	244,249,621	22,833	10,697
Theewaterskloof	176,381,059	86,719	2,034
Witzenberg	35,765,436	75,148	476
Total	**794,667,664**	**1,097,499**	**724**

This analysis estimates direct losses per capita per municipality for the 2008 November cut-off low, and involves two steps.

Step 1 spatially consolidates direct damage costs for **national**, **provincial** and **municipal** spheres within the each municipality affected by the November 2008 cut-off low (Table 7.7.1).

Step 2 calculates consolidated damage costs **per capita** within each municipality for the November 2008 severe weather event (Table 7.7.2).

This indicates the total damage costs per person in each municipality affected by the November 2008 cut-off low and 'adjusts' the severity of the event for population size.

November 2008: Cut-off low damage costs aggregated or 'ring-fenced' – what do the tables show?

The consolidated loss data for the November 2008 cut-off low show a very damaging inland event, with significant impacts for the Cape Winelands and Overberg district municipalities. Table 7.7.1 highlights the serious impacts sustained by farmers in the Breede Valley and the Langeberg – as well as those in Swellendam and Theewaterskloof. In fact, farm damage for this single event exceeded R631 million, or around 80% of total direct damage costs.

Table 7.7.2 adjusts these consolidated costs for the population size of the affected municipalities. It highlights once again the proportionately higher exposure of smaller, rural areas, where agriculture is the main source of livelihood. Repeat 'knocks' to farmers from severe weather, flooding, fires and drought have ripple effects on the entire local economy.

In the case of Swellendam, the consolidated losses were equal to R10,967 per person, or approximately five times more than with R2,034 per person calculated for Theewaterskloof.

Much of the damage to farms in the Cape Winelands and Overberg districts was due to floods that surged down water courses such as the Touws and Keisie Rivers as well as the Buffelsjags and Breede. In Theewaterskloof, serious farm damage resulted from the opening of the sluice gates at the Theewaterskloof Dam – which, reportedly, was filled to 106% at the time of the cut-off low.

7.8 Direct agricultural damage reported – November 2007, July 2008 and November 2008

Table 7.8.1 Agricultural damage costs reported in November 2007, July 2008 and November 2008

Municipality	November 2007			July 2008			November 2008		
	No. of farms	Direct damage cost (R)	Ave. direct damage cost per farm (R)	No. of farms	Direct damage cost (R)	Ave. direct damage cost per farm (R)	No. of farms	Direct damage cost (R)	Ave. direct damage cost per farm (R)
Cape Winelands District									
Langeberg	1	389,181	389,181	0	0	0	103	54,597,934	530,077
Breede Valley	1	885,054	885,054	2	535,890	267,945	142	144,372,588	1,016,708
Drakenstein	0	0	0	0	0	0	2	600,782	300,391
Witzenberg	0	0	0	0	0	0	5	34,176,436	6,835,287
Subtotal	2	1,274,235	637,117	2	535,890	267,945	252	233,747,740	927,570
Central Karoo District									
Beaufort West	2	438,865	219,433	0	0	0	0	0	0
Laingsburg	10	2,201,800	220,180	1	100,107	100,107	0	0	0
Subtotal	12	2,640,665	220,055	1	100,107	100,107	0	0	0
Eden District									
Bitou	2	185,080	92,540	0	0	0	0	0	0
Eden DMA	60	38,392,927	639,882	0	0	0	0	0	0
George	33	20,579,289	623,615	0	0	0	1	59,588	59,588
Hessequa	6	1,010,357	168,393	0	0	0	10	7,667,653	766,765
Kannaland	8	2,481,668	310,208	0	0	0	0	0	0
Knysna	4	470,168	117,542	0	0	0	0	0	0
Mossel Bay	22	4,610,414	209,564	0	0	0	0	0	0
Oudtshoorn	49	22,803,450	465,377	0	0	0	0	0	0
Subtotal	184	90,533,352	492,029	0	0	0	11	7,727,241	702,476
Overberg District									
Swellendam	8	1,476,635	184,579	0	0	0	34	213,744,698	6,286,609
Theewaterskloof	28	15,625,975	571,830	0	0	0	43	173,322,234	4,030,750
Cape Agulhas	0	0	0	0	0	0	3	3,397,361	1,132,454
Subtotal	36	17,102,610	475,073	0	0	0	80	390,464,293	4,880,804
West Coast District									
Bergrivier	0	0	0	10	1,565,038	156,504	0	0	0
Cederberg	0	0	0	14	6,495,443	463,960	0	0	0
Matzikama	0	0	0	30	13,309,089	443,636	0	0	0
Saldanha	0	0	0	1	207,707	207,707	0	0	0
Swartland	0	0	0	1	23,835	23,835	0	0	0
Subtotal	0	0	0	56	21,601,112	385,734	0	0	0
Total	**234**	**111,550,862**	**476,713**	**59**	**22,237,110**	**376,900**	**343**	**631,939,274**	**1,842,389**

7.8.1 Direct damage to farms, November 2007, July 2008 and November 2008 – what do the tables show?

It was only possible to consolidate farm damage information by municipality from November 2007. However, over three cut-off low events from November 2007 to November 2008, 636 farms were reported affected in the Cape Winelands, Overberg, West Coast, Central Karoo and Eden districts, with total direct losses estimated at R765.7 million.

The November 2007 event significantly affected agriculture in Eden, where 184 individual farms reported losses averaging R492,000 per farm.

In the July 2007 cut-off low that struck the West Coast, 56 farms reported losses, with 30 of these located in the Matzikama municipality and averaging a cost of R443,000 per farm.

The direct losses from the November 2008 cut-off low resulted in 252 and 80 farms sustaining losses in the Cape Winelands and the Overberg respectively. This was a particularly damaging flood event, with the costly estimates of damage in the affected farms ranging from R702,000 per farm in Eden to R928,000 in the Cape Winelands, to an extraordinary R4.8 million per farm in the Overberg. In Witzenberg and Swellendam, damage costs were over R6 million per farm for this event.

7.8.2 The failure of farm flood protection works – what does the November 2008 data show?

Although it was beyond the research scope to review all past farm losses, farm records for 2007 and 2008 show significant failure of flood protection works. Direct damage costs for farm flood protection works and canals in November 2007 were estimated at approximately R12.4 million, or around 14% of total agricultural damage. In November 2008 these reached a staggering R205 million – or 32.5% of total direct agricultural damage costs (see Table 7.8.2.1)

Table 7.8.2.1 Direct damage costs for farm flood protection works and canals in November 2008

Municipality	November 2008				
	No. of farms	Total Direct damage cost (R)	Protection works damage cost (R)	Canal damage cost (R)	Protection works and canal as a % of total
Cape Winelands District					
Langeberg	103	54,597,934	10,621,810	1,945,270	23.0
Breede Valley	142	144,372,588	19,256,082	154,030	13.4
Drakenstein	2	600,782	0	0	0.0
Witzenburg	5	34,176,436	192,865	0	0.6
Subtotal	252	233,747,740	30,070,756	2,099,300	13.8
Eden District					
George	1	59,588	0	0	0.0
Hessequa	10	7,667,653	4,797,413	46,876	63.2
Subtotal	11	7,727,241	4,797,413	46,876	62.7
Overberg District					
Swellendam	34	213,744,698	17,843,552	258,689	8.5
Theewaterskloof	43	173,322,234	150,188,789	47,670	86.7
Cape Agulhas	3	3,397,361	0		0.0
Subtotal	80	390,464,293	168,032,341	306,359	43.1
Total	**343**	**631,939,274**	**202,900,511**	**2,452,535**	**32.5**

Table 7.8.2.1 particularly highlights the farm damage sustained in the Overberg District, largely attributed to the failure of farm flood protection works in Theewaterskloof. For the 43 farms affected in this municipality, this represented approximately R3.5 million per farm in combined canal and flood protection works costs.

While such findings are critical for guiding agricultural risk management, more detailed analysis could not be undertaken. This is because the claim forms completed by farmers and submitted to the Department of Agriculture did not include a Surveyor-General's reference number – making it impossible for the research team to reference the affected farms spatially. Future geo-referencing of repeatedly flood-affected farms would enable better estimates of aggregate costs to agriculture within flood-prone catchments or municipalities. This would improve flood risk estimation, priority-setting and focused risk management in areas exposed to endangering floods.

7.9 Methodology used for collecting, consolidating and analysing loss information reported in *RADAR*

7.9.1 Overview

As indicated in Chapter 1, the data collection process that has enabled *RADAR* spans six years. It was made possible in part by post-event research commissioned by provincial and national government departments, as well as the City of Cape Town (CoCT). Valuable data were also collected through University of Cape Town (UCT) post-graduate Disaster Risk Science research on cut-off lows that affected Heidelberg (2004), Cape Agulhas (2005), the Southern Cape (2007) and the Cape Winelands/Overberg (2008).

The scale and complexity of the data collection are emphasised by the diversity of institutions and departments involved – as well as the sheer number of separate loss records that required consolidation. The data collection process involved one national department, two national agencies, eight provincial departments, five district municipalities, twenty separate local municipalities and three district management areas, as well as the CoCT. Three parastatal entities provided data, as did occasional reports from the insurance industry and input from irrigation boards. For the 2008 cut-off low event alone, the data collection and consolidation exercise involved over 712 separate loss records. Each of these required verification before being incorporated into the analysis.

Spatial analysis of the distribution of damage costs is now increasingly achievable, allowing for costs incurred for multiple sectors to be consolidated at municipal scale. For instance, the spatially robust information provided by Provincial Roads allowed for the identification and costing of road infrastructure that sustained repeat damage after recurring weather events. Similarly, there are encouraging efforts within some municipalities to use Global Positioning Systems (GPS) to spatially record sites that were affected by severe storms or flooding.

Figure 7.9.1.1 Example of a completed flood loss record developed by DiMP

Severe Weather Event Impacts (Nov 2007, July & Nov 2008)
Municipal Impacts

Organisation: [redacted]
Completed by: [redacted] Contact No: [redacted] Page No: 1

	Event Date	Impact Type	Impact Name	Spatial Coordinates	Damaged area In KM	Cause or contributing factors to Damage, i.e. debris, siltation etc	Cost of Damage
1.	Nov 07	Waternetwork	Norgariver – Damages to waterpipe	X:59,998.57 Y:3,764,639.69	N/A	Flood levels of river	150 000
2.	Nov 07	Waternetwork	Touw river – Damages to pipeline	X:36,064.60 Y:3,761,400.18	N/A	Flood situation in river	2 020 000
3.	Nov 07	Waternetwork	Waterworks - Wilderness	X:36,335.11 Y:3,732,392.57	N/A	Flood situation in river	1 400 000
3.	Nov 07	Sewer network	Gwaiing river gravity pipeline	X:53,092.25 Y:3,763,080.71	N/A	Flood situation in river	150 000
4.	Nov 07	Sewer network	Wilderness gravity main	X:30,700.53 Y:3,764,267.65	N/A	Flood situation in river	20 000
5.	Nov 07	Sewer network	Access roads to pumpstations	X:49,997.02 Y:3,763,194.64	N/A	Erosion of gravel roads	500 000
6.	Nov 07	Sewer network	Glenwood pumpstation	X:45,929.54 Y:3,760,338.65	N/A	Flood situation in river	195 000
7.	Nov 07	Sewer network	Kraaibosch gravity main	X:44,745.71 Y:3,761,707.22	N/A	Flood situation in river	20 000
8.	Nov 07	Sewer network	Gwaing rising main	X:53,835.59 Y:3,762,404.03	N/A	Flood situation in river	500 000
9.	Nov 07	Sewer network	Bos en Dal Pump station	X:51,216.79 Y:3,761,748.09	N/A	Flood situation in river	350 000
10.	Nov 07	Sewer network	Pacaltsdorp Pumpstation/ Scaapkopriver	X:49,44.75 Y:3,765,051.30	N/A	Erosion of riverbank	1 300 000
11.	Nov 07	Sewer network	Blanco gravity main	X:54,497.05 Y:3,758,322.01	N/A	Flood situation in river	125 000

However, this report unequivocally acknowledges its shortcomings in assessing and recording social impacts. The absence of a uniform methodology for assessing social impacts remains a troubling constraint. This study has been limited to extremely coarse indicators of hardship, including deaths and numbers of people evacuated or temporarily displaced. These simply do not capture the diversity of social impacts that include disrupted access to employment due to road damage, loss of insurance cover for retired residents in flood-exposed areas and increased child illness due to prolonged dampness in poorly constructed low cost homes.

Figure 7.9.1.1 below provides an example of a completed flood loss record developed by Disaster Mitigation for Sustainable Livelihoods Programme (DiMP). When submitted by an affected municipality, it enables uniform collection and consolidation of municipal damage data. This format has been successfully used by DiMP since 2003 to streamline information gathering across storm and flood-affected municipalities.

7.9.2 Sequence of steps for *RADAR*

The sequence of steps for the impact analysis documented in the *RADAR* publication is summarised in Figure 7.9.4.1. There are two main stages. The first stage, extending from August to September 2009, involved collecting data on the three remaining cut-off lows (2007–2008) that UCT had not yet studied.

The second and most extensive stage, from October 2009–March 2010, was reflected in careful consolidation of all data into Excel and analysis by event and sector. This was accompanied by spatial consolidation of data for the November 2007 and 2008 cut-off lows. These were the first severe weather events reported where aggregate farm losses were analysed within their respective municipalities.

7.9.3 Description of method for managing damage cost data

The research team recognised that inflationary pressures would need to be factored-into the analysis of damage costs over time. In consultation with Provincial Treasury, all costs were converted to 2005 values by applying inflation adjustment factors derived from national accounting data published in the Quarterly Bulletin of the South African Reserve Bank (http://www.reservebank.co.za). Specifically, a Gross Domestic Product (GDP) deflator computed from the real/nominal GDP was applied to damage costs reported for each severe weather event. These values are shown in Table 7.9.3.1.

Per capita loss estimates presented in this section applied 2007 population figures sourced from Statistics South Africa (StatsSA) which were based on the *Community Survey, 2007: Basic Results Municipalities* report.

Table 7.9.3.1 Deflator computed from the real and nominal GDP (2000–2008)

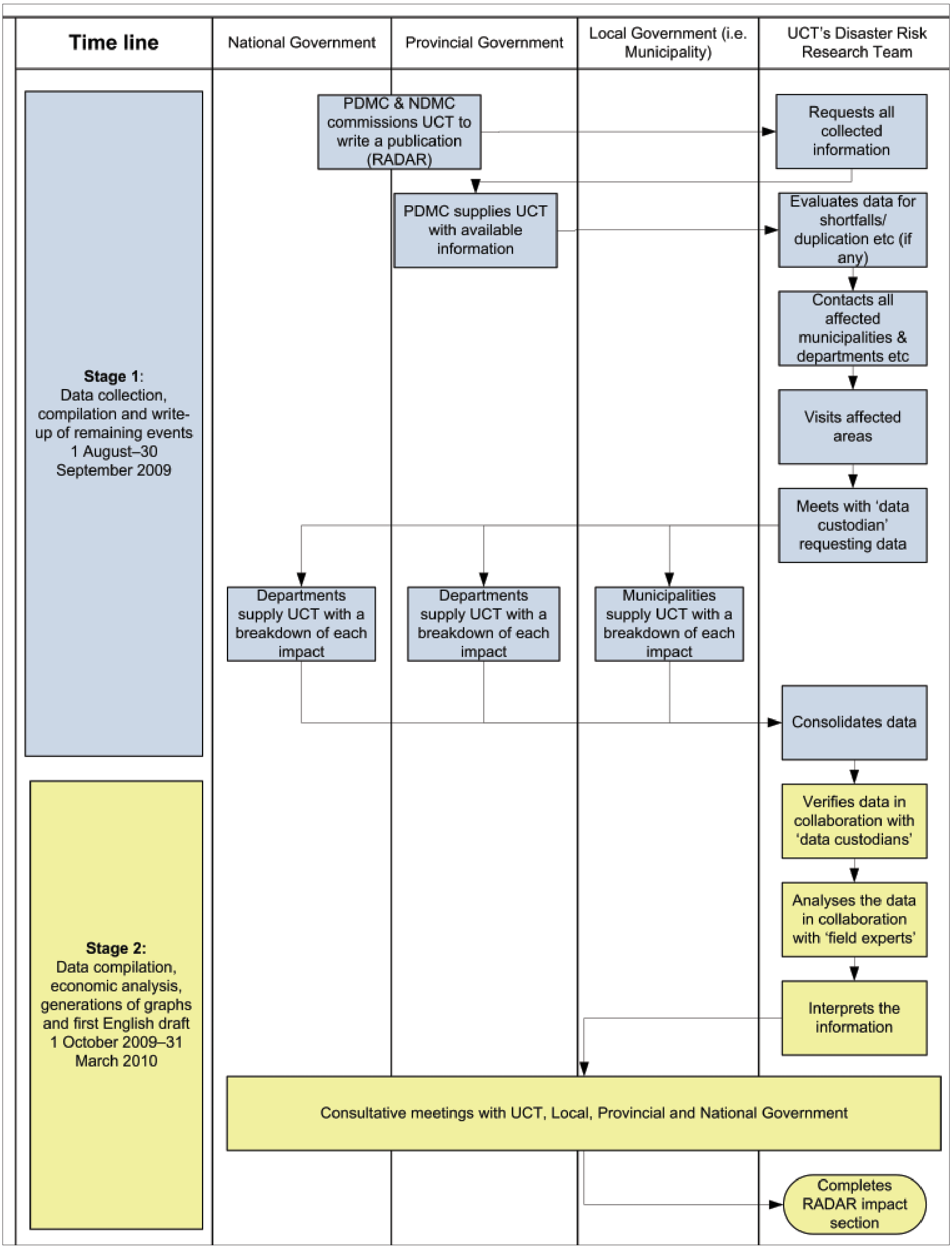
Year	Real GDP / nominal GDP	Inflation correction factor
2000	1122805 / 922147	1.2176
2001	1336962 / 1020008	1.3107
2002	1386435 / 1171085	1.1839
2003	1427322 / 1272537	1.1216
2004	1492330 / 1415273	1.0544
2005	1571082 / 1571082	1.0000
2006	1659122 / 1767422	0.9387
2007	1750139 / 2017102	0.8677
2008	1814521 / 2283822	0.7945

7.9.4 Data handling and spatial representation

Data were consolidated into Microsoft Excel for analysis and inflation adjustment. They were then consolidated by municipality and imported into ArcGIS® for mapping purposes.

Fine-scale spatial analysis, for instance along rivers, where numerous farm impacts were reported, was simply not possible due to the absence of spatial information on those farms damaged in each of the severe weather events.

Figure 7.9.4.1 Sequence of steps for the impact analysis for *RADAR*



To sum up...

- Disaster events represent 'realised risks' in which previously identified risks unfold into real and identifiable disaster events. These are defined by their times and dates, as well as respective locations, magnitude and effects.
- *Ex-post* studies of disaster events such as floods are useful for identifying areas, production activities and services that resist or fail in response to a severe weather shock.
- In the Western Cape, from 2003–2008, national departments and parastatals sustained direct damage costs exceeding R221 million in eight severe weather events.
- During the same period, eight provincial departments reported direct damage costs of R1.8 billion for these storms and associated floods.
- Damage costs attributed to agriculture over the eight severe weather events exceeded R1 billion and represented approximately 58% of losses reported by provincial departments. These costs combined direct losses reported by farmers as well as those incurred by the Provincial Department of Agriculture.
- The Provincial Road Department also reported significant damage costs of more than R600 million over the same period. These constituted approximately 35% of all damage costs reported by provincial departments.
- Damage costs reported by local and district municipalities for the same events totalled R513 million, with 70% of these incurred in the Eden District. Knysna reported the most significant flood damage costs, constituting around 18% of the total reported municipal losses.
- When damage costs for all organs of state are aggregated spatially by municipality and adjusted for population size, losses were proportionately greater in those municipalities with lower populations.
- Reported farm losses were particularly significant, with 636 farms recording damages in excess of R765 million from November 2007–November 2008.
- Failure of flood protection works is a recurrent concern, with R205 million in damaged farm flood protection infrastructure reported following the November 2008 cut-off low. This was particularly marked in Theewaterskloof, where 43 farms sustained damage to flood protection works estimated at R150 million.

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