



OFF the RADAR - Summary Report

High Impact Weather Events in the Western Cape, South Africa 2003 - 2014

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2003 - 2014

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ACRONYMS

APMF	Associated Programme on Flood Management
COL	Cut-Off Low
CBD	Central Business District
CoCT	City of Cape Town
DAFF	Department of Agriculture, Forestry and Fisheries
DCoG	Department of Cooperative Governance
DEA&DP	Department of Environmental Affairs and Development Planning
DiMP	Disaster Mitigation for Sustainable Livelihoods Programme
DMA	Disaster Management Act
DoA	Departments of Agriculture
DRM	Disaster Risk Management
DRMC	Disaster Risk Management Centre
DTPW	Department Transport and Public Works
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMS	Emergency Medical Service
ENSO	El Niño Southern Oscillation
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EWS	Early Warning System
FEWS	Famine Early Warning Systems
GDP	Gross Domestic Product
GWP	Global Water Partnership
HIWE	High Impact Weather Events
HPNGB	Harold Porter National Botanical Gardens
IDPs	Integrated Development Plans
IPCC	Intergovernmental Panel on Climate Change
IWEE	Institute for Water and Environmental Engineering
JOC	Joint Operations Centre
MIMMS	Major Incident Medical Management and Support
MEC	Member of the Executive Council
NCEP	National Centres for Environmental Prediction
NDMC	National Disaster Management Centre
NDMF	National Disaster Management Framework
NEMA	National Environmental Management Act
PSP	Professional Service Provider
RADAR	Research Alliance for Disaster and Risk Reduction
RMMP	River Maintenance and Management Plan
SAFFGS	South African Flash Flood Guidance System
SANDF	South African National Defence Force
SANParks	South African National Parks
SANRAL	National Roads Agency
SAPS	South African Police Service
SASSA	South African Social Security Agency
SAWS	South African Weather Service
SCS	Soil Conservation Service
UNISDR	United Nations International Strategy for Disaster Reduction
US EPA	United States Environmental Protection Agency
WCDMC	Western Cape Disaster Management Centre
WMO	World Meteorological Organisation
WUA	Water User Association
ZAR	South African Rands

INTRODUCTION

Between 2011 and 2014, the Western Cape was severely affected by five high impact weather events (HIWE) that led to four flood disasters. All five of the flood-triggering weather processes were identifiable Cut- Off Low (COL) pressure weather systems that respectively passed through the province between 7-9 June 2011, 13-14 July 2012, 7-11 August 2012, 15-17 November 2013 and 6-10 January 2014.

In accordance with the National Disaster Management Framework (NDMF), four in-depth studies were conducted on the HIWE. These were undertaken by the Research Alliance for Disaster and Risk Reduction (RADAR) at Stellenbosch University, in collaboration with the Western Cape Provincial Disaster Management Centre (WCDMC), and the Western Cape Departments of Agriculture (DoA) and Transport and Public Works (DTPW).

This report, Off the RADAR - Summary Report: High Impact Weather Events in the Western Cape, South Africa 2003-2014, consolidates the Executive Summaries from the Synthesis Report and four detailed Background Papers on the main findings and impacts for each of the disasters, as well as recommendations for action.

It represents the companion document to the more detailed Synthesis Report that analyses multi-sectoral and other information from the four disaster events.

Off the RADAR - Summary Report: High Impact Weather Events in the Western Cape, South Africa 2003-2014 - Downloaded at: <http://www.riskreductionafrica.org>

<https://www.westerncape.gov.za/general-publication/disaster-operations>

Off the RADAR - Synthesis Report: High Impact Weather Events in the Western Cape, South Africa 2003-2014 - Downloaded at: <http://www.riskreductionafrica.org>

<https://www.westerncape.gov.za/general-publication/disaster-operations>

Detailed Background Reports

Four detailed background reports were completed for each of the four HIWE, including their hydrometeorological attributes. Each is between 60-90 pages in length.

Report Number	Title
COL Report No. 1	Post-Event Review: June 2011 High Impact Weather Event in the Eden and Cape Winelands District Municipalities.
COL Report No. 2	Post-Event Review: July-August 2012 Disasters in the Cape Winelands, Central Karoo and Eden District Municipalities.
COL Report No. 3	Post-Event Review: November 2013 Cut-off Low Event in the City of Cape Town and Cape Winelands, Eden, Central Karoo and Overberg District Municipalities.
COL Report No. 4	Post-Event Review: January 2014 Flood Disaster in the Cape Winelands, Central Karoo, Overberg and Eden District Municipalities

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1. SUMMARY: OFF THE RADAR HIWE SYNTHESIS REPORT 2003-2014

1.1 Background

Between 2011 and 2014, the Western Cape was severely affected by five HIWE that led to four provincially gazetted flood disasters. All five of the flood-triggering weather processes were associated with identifiable COL weather systems that respectively passed through the province between 7-9 June 2011, 13-14 July 2012, 7-11 August 2012, 15-17 November 2013 and 6-10 January 2014.

The resulting disasters were characterised by widespread flooding, with impacts reported across most of the Western Cape Province. Outside of the Cape Metro, 12 people lost their lives, while more than 23 000 were affected in informal settlements and low-cost housing areas, as well as farms and more affluent areas. Flash-flooding associated with the 15 November 2013 COL forced the rescue of 121 patients from the Mediclinic Vergelegen in Somerset West, the first evacuation of an entire hospital recorded on the continent. The same system affected 18 000 residents in 44 informal settlements within Cape Town.

Government departments (excluding the Western Cape DoA) and affected municipalities reported financial losses in excess R 682.8 million. Farm costs and losses linked to COL weather systems and associated flooding were estimated at R 900.5 million, constituting 56.9% of the total. Altogether, total financial costs/losses to government departments, municipalities and the agricultural sector were estimated at R 1.6 billion.

1.2 Research Methodology

In accordance with the NDMF, which requires post-event reviews following disasters and significant events, in-depth multidimensional studies were conducted for each of the four disaster events. Specifically, the study sought to:

- Understand the five weather systems and their hydrological effects.
- Identify measures to mitigate, anticipate and manage the systems' effects.
- Determine the impacts of the events, including social consequences, infrastructural damage and agricultural losses.
- Document the financial losses sustained.
- Identify high-risk areas and infrastructure and the implications for disaster management, climate risk management and sustainable urban and development planning.

The research was undertaken by RADAR at Stellenbosch University, in collaboration with the WCDMC, and the Western Cape DoA and DTPW.

It examined the 2011-2014 COL-related disasters as a series of HIWE, or *"weather that can result in significant impacts on safety, property and/or socioeconomic activity."*¹ It was undertaken as a complex, multi-stage transdisciplinary research project that combined in-depth examination of each declared disaster (2011-2014), with cross-cutting meteorological and hydrological analyses and two nested case-

¹ Sills, D. M. (2009) 'On the MSC forecasters forums and the future role of the human forecaster', *Bulletin of the American Meteorological Society*, vol. 90, no.5, pp. 619-627.

studies. In the second analytic phase, findings from eight previous ex post COL studies were integrated with the 2011-2014 data to identify recurrent and changing risk conditions across more than a decade's high impact weather disasters.

1.3 Summary of Impacts

1. From 2003-2014, there were 12 disasters associated with 14 identifiable COL weather systems in the Western Cape, signalling that high impact weather conditions and damaging floods are not 'rare events' (refer to Table 1).
2. They occurred almost annually, with extensive and recurrent financial losses. From 2003-2014, R 4.9 billion in flood-related damage was reported by government departments and municipalities. Of this, R 2.3 billion was due to agricultural costs.
3. COL-associated associated damage varied seasonally, with average municipal costs in warmer months more than doubling those in cooler periods. Average September-February municipal disaster costs were estimated at R 120.2 million per event compared with R 47.6 million for individual disaster events from March-August.
4. From 2003-2014, Hessequa Local Municipality in Eden reported damage for eight of the 12 events and cumulative losses of R 178 million. George reported R 178 million in damage for six events and Knysna recorded R 142 million for five disasters.
5. Social impacts were wide-ranging but poorly documented, and included deaths, evacuations and temporary isolation. Twenty-three lives were reportedly lost, with more than 30 800 people affected or evacuated. Outside of the Cape Town Metro, the Langeberg Municipality reported the largest number of residents affected or evacuated (6 400). Results indicate that inland residents are at increased flash-flood risk, especially in the Langeberg and Laingsburg municipalities. Meiringspoort also represents an identifiable flash-flood hot-spot.
6. Critical facilities and essential services are at-risk. In the 2012 and 2013 COL-induced disasters alone, impacts included the loss of an ambulance attendant on duty and a hospital evacuation, while wind/rain damage were reported for 23 schools within the City of Cape Town (CoCT).
7. From 2011, the national introduction of more rigorous infrastructural damage assessment procedures for recovery reconstruction has reduced the range, specificity and accuracy of reported losses. This has weakened the quality of municipal and provincial disaster risk surveillance, especially for non-infrastructural and recurrent impacts.

Extreme daily COL-induced rainfall has become more frequent

1. There is an identifiable recent increase in the frequency of extreme daily rainfall associated with COL weather systems. This is also associated with record flood peaks in several rivers during the past decade.
2. The COL weather systems were associated with heavy rainfall as well as other potentially damaging conditions, including snow and hail.
3. COLs occurring in the warmer months have potential to be particularly damaging.

Developmental conditions drive flood risk

Despite their almost annual occurrence, there is still a widely held misperception that '*floods*' are '*disasters*'. This has discouraged the incorporation of flood risk management into integrated development plans (IDPs) and funding models.

1. Developmentally-driven flood risk factors continue to escalate the likelihood of endangering floods. These include shortcomings in integrated catchment and river management that increase flood exposure, especially the *build-up of sediment* of riverbeds around bridges and culverts.
2. They also include inadequate removal of alien vegetation and debris from rivers and floodplains.
3. Incremental changes associated with development and agricultural practices have increased flood risks by altering catchment conditions. Residential, commercial and infrastructural expansion and densification in flood-prone areas have not only placed homes, facilities and infrastructure in harm's way, but also impeded the flow of natural watercourses and overland run-off during heavy rain.

High impact weather responders and forecasters are under pressure

1. The Western Cape Province benefits from high levels of committed, effective and skilled disaster (risk) management and emergency services practitioners.
2. However, current flash-flood forecasting and communication approaches were too broad-brush to give advance warning to specific areas under threat or to accurately inform action. This applied especially to municipalities in the Karoo and mountainous catchments.
3. Constrained weather radar coverage severely hampered early warning of high impact weather conditions and prevented effective implementation of the South African Flash Flood Guidance System (SAFFGS). This especially applied to inland municipalities where there are tight time-frames for evacuation and life-saving response, but large distances to cover and major resource constraints.
4. Social media is a powerful medium in disaster responses, with potential to be a formidable resource for informed decision-making and disseminating disaster-related information.

1.4 Recommendations

1.4.1 Improve COL and flood risk understanding as well as on-going surveillance

The WCDMC should consult with appropriate national, provincial and municipal authorities to:

1. Assess and address sedimentation levels in flood-prone areas on an ongoing basis. This includes the impact of sediment accumulation on flow capacity for bridges and culverts carrying regional and district roads across flood-prone river channels.
2. Engage with the Department of Water and Sanitation (DWS) to evaluate progress of rectification processes to reduce safety risks at various large and medium dams. This particularly applies to the Karoo where sediment loading and retention are high. Where progress is slow or delayed, increased downstream flood exposure must be identified and communicated to the affected parties.
3. Identify critical facilities and infrastructure exposed to flooding, as well as areas at risk of isolation during flood events, such as in the Langeberg Municipality, Hout Bay and Meiringspoort. Contingency plans need to be established to assist in strengthening and streamlining future responses to flooding in these localities.
4. Identify hospitals and health facilities that are potentially flood-exposed. Provincial Emergency Medical Service (EMS) should consider and investigate the scope for making flood-risk assessment a requirement for hospitals.
5. Revisit and harmonise current approaches to disaster risk assessment as well as post-disaster loss estimation in the province, to improve the range, accuracy and spatial specificity of losses. This information should proactively inform and update purposive resilience programming within integrated development planning processes.

1.4.2 Strengthen institutional capacity to manage COL-induced flood risks

The WCDMC should consult with appropriate national, provincial and municipal authorities to:

1. Reinforce the need for prospective flood risk management. Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. Resilience planning and funding mechanisms should be prioritised for high-risk areas.
2. Deepen institutional memory related to HIWE and their effects within district and local disaster management authorities to build more robust disaster management capacity.
3. Urgently address gaps in the provisioning of emergency response vehicles, particularly in flash-flood-prone and rapidly isolated areas such as the Langeberg Municipality. Emergency response capabilities in these areas should also be enhanced.
4. Explore the role of Neighbourhood Watches and similar institutions as local resources. DRM and response planning processes should identify local capacity and engage to proactively strengthen planning and response.
5. Assist in clarifying the roles and responsibilities in the case of emergencies facing private health facilities. While EMS is mandated and best placed to manage responses concerning health facilities, the respective roles, and chains of command should be clearly defined.

1.4.3 Invest in flood resilience building to protect development gains

The WCDMC should consult with appropriate national, provincial and municipal authorities as well as the private sector to:

1. Ensure that new infrastructure is designed to withstand current risk conditions, as well as possible future upward trends in weather extremes and climate variability.
2. Ensure that flood prevention and preparedness, including cleaning of drains are implemented year-round (not just before winter rainy season).
3. Increase oversight of alien clearing processes, to ensure that cleared vegetation is removed properly from the riparian zone, as specified by the DWS.
4. Support DoA efforts to enable farmers to reduce erosion by encouraging improved farming and land care practices, and advancing river protection efforts, including holistic, system-level river management processes.

1.4.4 Improve both disaster preparedness and capacities to 'build back better'

The WCDMC should consult with South Africa Weather Service (SAWS) to:

1. Collaboratively and urgently address gaps in weather radar coverage, especially for the Province's inland areas. This includes new and additional radars so the SAFFGS can function protectively and to enable impact-based forecasting.
2. Explore mechanisms to introduce integrated flash flood early warning systems at hotspots that combine SAWS warnings, an enhanced version of the SAFFGS, radars (where feasible), automatic weather stations, real-time river gauges, cameras, community EWS, and in specific critical basins, complex hydrological modelling.
3. Provide more spatially specific impact-based forecasts to provide finer-scale information that captures meteorological variability between areas, and improves forecast information at the local level, to fine-tune pre-emptive responses.

The WCDMC should consult appropriate national, provincial and municipal especially local disaster management officials to:

1. Improve risk communication mechanisms that target flood-exposed populations more effectively, especially those in informal settlements. In Eden District Municipality, this should also include communities living along the Keurbooms River and tourists and others likely to travel through flash flooding hotspots such as Meiringspoort.
2. Improve the effectiveness of social media, by incorporating social media systematically into awareness and flood risk communication strategies.
3. Expedite post-disaster recovery and reconstruction funding processes to support risk reduction imperatives, particularly in less-resourced local municipalities.
4. Develop guidelines to 'build back better' as urged by the Sendai Framework for Disaster Risk Reduction. (There needs to be greater emphasis on risk reduction in the repair of damaged infrastructure to strengthen its resilience for flood and other high impact weather exposures).

1.4.5 Strengthen disaster risk management (DRM) capacities in hospital facilities

The WCDMC should consult with Provincial EMS in connection with potentially flood-exposed medical facilities to:

1. Sensitise senior hospital managers to environmental and climate conditions that stand to create unexpected emergencies.
2. Advise managers of both private and public health care facilities in areas potentially exposed to flooding, to undertake risk assessments to inform appropriate risk reduction efforts and planning.
3. Develop evacuation protocols that establish criteria for proactive action and decision-making. These should be based on a strengthened relationship between disaster management authorities and provincial EMS.
4. Ensure continuity of services by planning and preparing for communication and electricity failures/interruptions.

1.4.6 Prioritise DRM in the agricultural sector

As stressed in previous post-disaster studies within the Western Cape, the agricultural sector sustains unacceptably high recurrent costs due to exposures to high impact weather, flooding and drought. This study shows that 56% of total costs reported by government entities from 2011-2014 were attributed to agriculture.

It is urged that the DoA prioritise its institutional capacity for agricultural risk management. Specifically, the DoA should review the recommendations outlined in the draft Department of Agriculture, Forestry and Fisheries (DAFF)-commissioned Feasibility study on the decentralisation and institutional capacity development for DRM within DAFF² and actively consider the following:

1. "Establish a dedicated DRM unit for agriculture in each province. The unit functions within the respective provincial department of agriculture and becomes part of its hierarchy, similar to the DRM within DAFF. In such a case the unit must be correctly located in the structure so that it has the mandate and ability to coordinate DRM activities across all sectors. These units must also be staffed and funded to achieve their objectives" (DAFF, 2014:14).

² Department of Agriculture, Forestry and Fisheries (2014) 'Feasibility study on the decentralisation of institutional capacity development for the Directorate Agricultural Disaster Risk Management'. Technical report 2013 (draft).

2. “Funding should be made available for DRR and disaster response activities as per the Disaster Management Act (DMA) and NDMF³. Specifically 1.2% of each sub department’s budget as required by the NDMF (see page 104) should go to contingency fund for disaster response activities at both levels. This percentage allocation would ensure alignment with the DMA and NDMF. For operational budgets it is advised that provincial and national departments along with Provincial and National Treasuries take responsibility for funding provincial units” (DAFF, 2014:8).
3. “DAFF should urge the National Disaster Management Centre (NDMC) to develop and put guidelines in place as per the NDMF to eliminate red tape for disaster relief funding within the sector. Provincial units and affected groups should also be made aware of the correct procedures to follow to access funding from Department of Cooperative Governance (DCoG) -NDMC” (DAFF, 2014:8).

³ The Disaster Management Act was amended in 2015 by the Disaster Management Amendment Act (No. 16 of 2015). <http://www.gov.za/documents/disaster-management-amendment-act-16-2015-15-dec-2015-0000>

Table 1: Summary of the COL weather events & their effects 2003 – 2014

Date	Event type & area affected	Social impacts	Damage (R mil)	Heaviest total rainfall
Mar 2003	COL: Cape Winelands, Eden, Overberg	More than 3 000 people evacuated. Three deaths in Hermanus and Knysna.	343.4	Langeberg, 241mm
Dec 2004	COL: Cape Winelands, Eden, Overberg	3 700 homes and 40 business premises damaged.	83.3	Knysna, 218.8mm
Apr 2005	COL: Cape Agulhas Municipality	Residents of Kleinbegin flood affected.	12.7	Cape Agulhas, 228mm
Aug 2006	Two COLs: Cape Winelands, Eden, Overberg, Central Karoo	Approx 1 600 people displaced. Five fatalities.	691.4	1: George, 327.8mm 2: Swellendam, 24mm
Jun 2007	COL, followed by a mid-latitude cyclone: West Coast and Cape Winelands	People from low-cost housing, informal settlements and farms evacuated.	159.6	COL: Bergrivier, 280-318mm Mid-latitude cyclone: Witzenberg, 50mm
Nov 2007	COL associated with black southeaster: Cape Winelands, Overberg, Central Karoo and Eden	Approx 2 400 people from low cost housing, informal settlements and farms either provided with relief or evacuated; two fatalities.	1 191.5	George, 458.8mm
Jul 2008	COL and strong south easterlies: West Coast	One fatality in Langeberg.	82.0	Roode Els Berg, 275mm
Nov 2008	COL associated with black southeaster: Overberg, Cape Winelands and Eden	More than 1 400 people from informal and low-cost settlements evacuated. Households cut-off and Knysna Central Business District (CBD) flooded. One death in Hessequa.	1 138.7	Hessequa, 247.5mm
Jun 2011	COL: Cape Winelands, Central Karoo, Eden and Overberg	More than 2 000 affected Knysna Oyster Festival and Marathon cancelled. Five fatalities in George, Langeberg and Oudtshoorn.	348.0	Mossel Bay, 299.2mm
Jul-Aug 2012	COL combined with a low-level cold front in July: Heavy snow in Eden and the Central Karoo. COL in August: Flooding in the Cape Winelands and Eden	More than 19 000 people in informal settlements and low-cost housing affected across the province. 121 patients evacuated from Mediclinic Vergelegen. Water supply to Worcester disrupted. Two fatalities in the Stellenbosch area.	377.7	July: George, 111.5mm August: George, 131mm
Nov 2013	COL combined with a warmer tropical-temperate trough and a low-level low pressure system: CoCT, Cape Winelands, Overberg and Eden	Water supply to Laingsburg and Riversdale disrupted. 33 people trapped in Meiringspoort. Relief provided to people in Cape Winelands and Eden; Four fatalities in Cape Winelands.	167.5	Theewaterskloof, 231.4mm
Jan 2014	COL combined with a tropical low pressure system Central Karoo, Eden and Overberg		465.5	Somerset West, 389.2mm

2. HIGH IMPACT WEATHER EVENT SUMMARY

REPORT No. 1: 7- 9 JUNE 2011

From 7-9 June 2011, a weather system over the southern part of the Western Cape resulted in heavy rainfall and flooding, particularly in the Eden and Cape Winelands District Municipalities. Cumulatively, stations in Mossel Bay recorded the most rain (299.2 mm), but weather stations in Laingsburg (205 mm), Swellendam (183.6 mm), George (166.6 mm) and Kannaland (132.7 mm) Municipalities also recorded heavy rainfall. Hydrological data indicates very high river flows, particularly in George and Mossel Bay.

2.1 The event's impacts

The event resulted in widespread social impacts. One person drowned in Hessequa and communities throughout Eden District Municipality experienced flooding. A total of 1 107 people were evacuated from informal settlements and low-cost housing areas. Knysna's CBD was flooded. In the Cape Winelands, Langeberg Municipality experienced widespread flooding. Households were evacuated from informal settlements in Ashton and sewerage and water infrastructure was damaged in Robertson. There were numerous road closures in both District Municipalities, including closures to main thoroughfares such as the R62, Garcia Pass and exits from the N2. Many schools were affected by flooding.

A range of systemic drivers increased the impact of the event, including ageing infrastructure, which is often built to outdated design standards less appropriate for prevailing conditions, as well as inadequate human and financial resources, particularly in smaller municipalities. River management, including incomplete resolution of alien clearing projects, may drive risk in some areas. Sedimentation, linked to both wildfires and alien vegetation infestation, may also contribute to the severity of flooding, particularly in the Karoo.

Financial losses sustained

In total, the event resulted in damages of R 242.7 million (these values differ to those reported in the Synthesis Report as they were **not adjusted** for inflation). The Eden District Municipality sustained the bulk of the financial losses (R 242 676 691), with Kannaland Municipality sustaining the highest losses (R 65 936 409), followed by George (R 64 687 600) and Hessequa (R 61 305 859). All the municipalities except for Oudtshoorn reported damage costs to both provincial and municipal government, with the reported damage in Oudtshoorn confined to the DTPW. The national DWS reported damage to dams and gauging stations in Swellendam.

2.2 Key features of the institutional response

Prevention and planning

- The research identified mitigation as a key theme. Mitigation measures adopted following the floods in Eden District Municipality in 2006 and 2007, such as estuary breaching protocols and improved stormwater management, may have reduced the storm's impact, although rainfall and hydrological data suggest that the event's magnitude was lower than those of in 2006 and 2007. Several municipalities have upgraded infrastructure and prioritised maintenance and clearing, but insufficient investment in stormwater infrastructure remains a risk driver in many areas.

- Risk reduction and disaster response have benefited from improved coordination among role-players at multiple scales. This includes improved relationships between disaster management and other actors, as well as coordination within local and district disaster management services.

Early warning

- SAWS warnings served to ramp up the response to the event in Eden, but the warnings failed to forecast rain in Langeberg Municipality. This is in large part linked to inadequate weather radar capacity, which severely constrains accurate forecasting and warning for the Province's interior.
- The SAWS weather alerts reached most governmental role-players involved in responding to flooding, but the study suggests that information is not always reaching those at risk, particularly people living in informal and low-cost housing settlements.
- In Eden District Municipality, Disaster Managers and others felt that alerts also lacked the precision needed for effective decision-making, particularly in areas with high levels of meteorological variability such as along the Garden Route.

Emergency response and relief

- The flooding in 2011 occurred in the context of a relatively well-practised institutional response, honed by repeated HIWE. In Eden, the systematic storage of food parcels and other relief items helped to speed up the distribution of relief, although inadequate supplies slowed the provision of relief in some areas.
- Pre-emptive evacuations by the authorities and others in areas such as Wilderness, in George Municipality, helped to ameliorate the impact of the event.

2.3 Recommendations

2.3.1 Risk reduction and building resilience

Recommendations to national, provincial and municipal government

- Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. Resilience planning and funding mechanisms should be prioritised for high-risk areas.
- New infrastructure needs to be designed to withstand current risk conditions, as well as a possible up-trend in both extreme weather events and climate variability in the future. Design parameters should be assessed to ensure that they are appropriate to current and future conditions.
- There needs to be greater emphasis on mitigation in the repair of damaged infrastructure following high impact weather events. Rehabilitation projects must “build-back better”, with a view to strengthening infrastructural resilience to flooding.

River management

Recommendations to national, provincial and municipal authorities

- Sedimentation levels in flood-prone areas should be assessed and addressed on an ongoing basis. Assessments should consider the capacity for bridges and culverts carrying regional and district roads over river channels given sediment accumulation.
- There needs to be greater oversight of alien clearing processes, to ensure that cleared vegetation is removed properly from the riparian zone, as specified in DWS policy.

Early warning

Recommendations to national and provincial government

- Gaps in weather radar coverage should be urgently addressed, especially for the Province's inland areas. This will also enable the SAFFGS to function protectively.

Recommendations to SAWS and the WCDMC

- SAWS should explore available means of refining forecasts to provide finer-scale information that captures meteorological variability between areas.
- SAWS and disaster management authorities should work together to strengthen capacity to interpret forecast information at the local level, to fine-tune pre-emptive responses.

Recommendations to municipal authorities

- Disaster management authorities should explore dissemination mechanisms that target more effectively populations living in informal settlements.

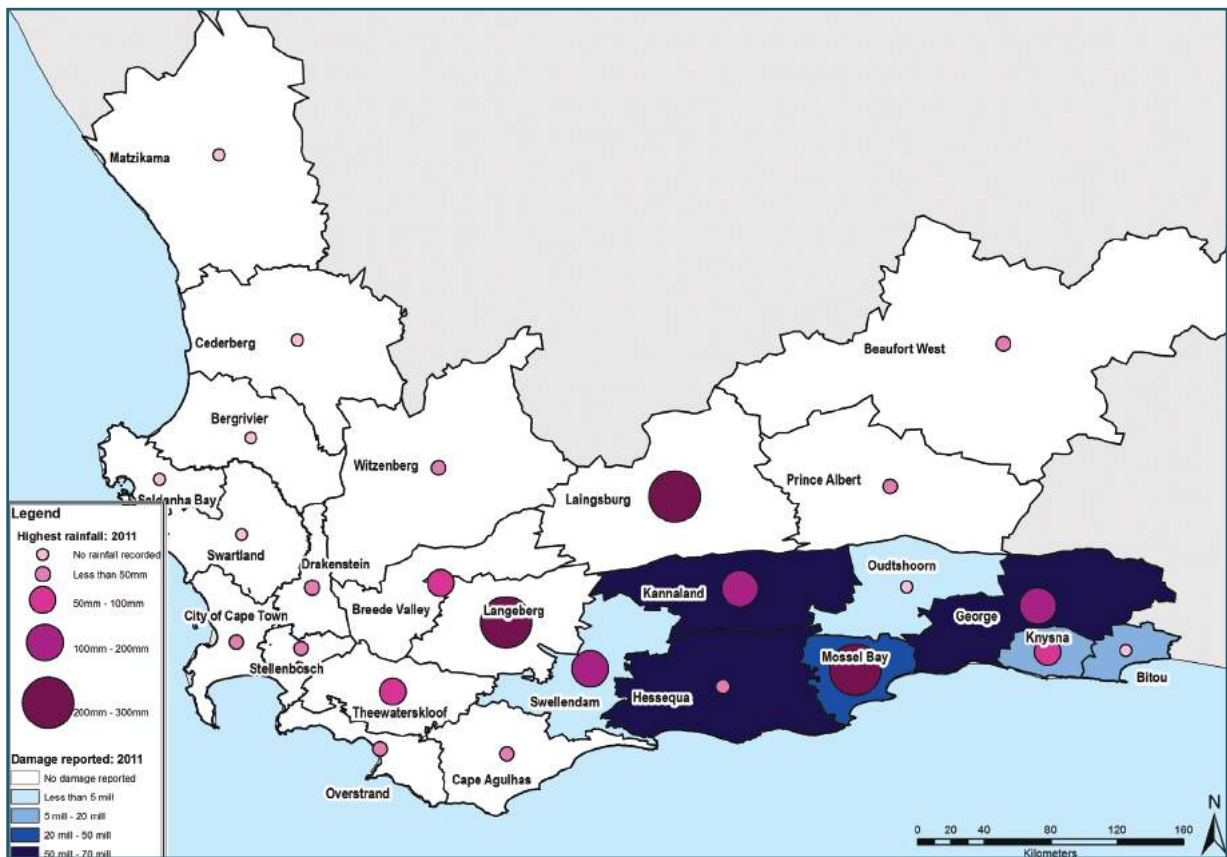


Figure 1: The rainfall and direct financial impacts for the June 2011 event

Table 2: Summary of the June 2011 HIWE

Date	7 – 9 June
Areas affected	Primarily Cape Winelands and Eden District Municipality, but also Overberg and Central Karoo District Municipalities
Total heaviest rainfall	Mossel Bay, 299.2 mm
Social impact	1 111 people evacuated in Eden & Central Karoo District Municipalities 41 schools in the province were temporarily closed. Knysna’s Central Business District flooded Extensive road closures
Financial losses*	R 348.0 million, excluding costs to the DoA R 371.1 million, including river protection work by the DoA
Key findings Forecasting in the Province is challenging and warnings lack precision to inform decision-making	<ul style="list-style-type: none"> • Gaps in weather radar coverage should be urgently addressed, especially for the Province's inland areas. SAWS should explore available means of refining forecasts to provide finer-scale information that captures meteorological variability between areas. • SAWS and disaster management authorities should work together to strengthen the capacity to interpret forecast information at the local level, with a view to fine-tuning pre-emptive responses.
Ageing infrastructure, and challenges in the maintenance and upgrading of infrastructure increase risk	<ul style="list-style-type: none"> • Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. • Design parameters must be appropriate to current and future weather conditions. • Resilience planning and funding mechanisms should be prioritised for high-risk areas. • Rehabilitation projects must “build-back better”.
River management contributes to flood-risk in many areas	<ul style="list-style-type: none"> • Sedimentation must be monitored and addressed. • There needs to be greater oversight of alien clearing processes, to ensure that cleared vegetation is removed properly from the riparian zone.

***These values differ to those in the Synthesis Report as they were not adjusted for inflation.**

3. HIGH IMPACT WEATHER EVENT SUMMARY

REPORT No. 2: JULY/AUGUST 2012

In July and August 2012, two consecutive high impact weather systems brought heavy rain and very cold conditions to the Western Cape. The first, between 13 and 14 July, and the second between 7 and 9 August, affected most of the Western Cape, but particularly the Eden, Central Karoo and Cape Winelands District Municipalities. Although cold and wet conditions were felt more widely, Eden and Central Karoo were most affected by the first event in July, while the second affected primarily the Cape Winelands District - the Langeberg Municipality in particular. The magnitude of the losses led to the declaration of a provincial disaster on 19 November 2012.

3.1 The events' impacts

The rainfall in July was associated with the confluence of two weather systems, a COL and a low-level cold front, creating conditions favourable for heavy rainfall. The rainfall in August was associated with a decaying COL located to the south east of the sub-continent. Rainfall readings for the first event show that stations along the border between Bitou and the Eastern Cape, George and Mossel Bay received the most rainfall over the course of the event (255 mm, 11.5 mm and 106.7 mm respectively). George Municipality recorded the highest rainfall (131 mm) during the August event, with Langeberg Municipality receiving 103 mm.

During the July event, rivers in Bitou and Knysna recorded very high flow levels, but rivers in George and Mossel Bay generally recorded lower flows than in 2011. Rivers in the Langeberg experienced high flow levels, but these were less extreme compared to previous events.

The HIWE in July 2012 resulted in significant social impacts. Three people lost their lives. The rain coincided with the annual Knysna Oyster Festival and Marathon, which were both cancelled, representing a significant knock for the tourism industry in Knysna. Informal settlements and low-cost housing areas throughout Eden were flooded, with 316 people evacuated over the course of the event. In the Central Karoo, more than 200 vehicles and five buses were trapped in snow on the N1 near Beaufort West, and seven farms were cut-off. People from three of these farms needed to be rescued by helicopter.

The storm in August 2012 also impacted significantly on affected communities in the Cape Winelands District Municipality. Several people lost their lives, including an ambulance driver, whose vehicle was washed off a bridge in Montagu. Approximately 1 400 people were evacuated from low-income settlements in Ashton, Montagu and McGregor. The storm also resulted in extensive road closures, including the R62 through the Cogmanskloof Pass, as well as damage to water and sewerage infrastructure in Montagu and Ashton. Montagu Springs Resort was flooded, negatively affecting tourism in the area following the floods.

A range of systemic drivers increased the impact of the event. In addition to ageing infrastructure, these included inadequate human and financial resources, and a reliance on disaster funding, particularly in less resourced municipalities. River management, including incomplete resolution of alien clearing projects, and sediment accumulation (aggradation) may also have increased the risk and impact of flooding in some areas.

3.2 Financial losses sustained

The financial losses were sizeable. The event resulted in damages of R 51 499 204 million, excluding costs claimed by the DoA. The Langeberg Municipality sustained the highest damages, amounting to R 18.4 million, followed by Bitou and Oudtshoorn Municipality (R 12.5 million). These losses were almost exclusively for provincial (R34.5 million) and municipal (R 16.9 million) infrastructure. The DTPW reported the bulk of reported provincial losses. After including DoA-reported costs, the financial costs for the two weather events increased markedly, to R425 032 204 (the DoA-reported costs however, reflected river protection works aimed at mitigating the risk of flooding, implemented following the events – rather than repairs to farm infrastructure). These values differ to those reported in the Synthesis Report across all four COL disasters as they were **not adjusted** for inflation.

3.3 Key features of the institutional response

Prevention and planning

- The research identified mitigation as a key theme. In Eden District Municipality, mitigation measures implemented by municipalities included proactive estuary-breaching protocols in the event of heavy rain as well as improved storm-water management. The Langeberg Municipality also upgraded several bridges, and implemented major river works in Montagu aimed at addressing recurrent flooding.

Early warning

- The severe weather event in June 2011 (see Report 1 of this series), heavy rainfall was not forecasted for the Langeberg area in August 2012, and municipal staff reported that no weather warnings were received from the SAWS. As a result, contingency mechanisms that would usually activate in advance of a storm were not triggered – although it is unclear to what extent this affected the response. The situation in the Langeberg Municipality is in large part linked to inadequate weather radar capacity, which severely constrains accurate forecasting and warning for the Province's interior.
- The generalised nature of warnings was also reported as a challenge, with information is not always reaching those exposed to flooding. Disaster managers noted that alerts lacked the precision needed for effective decision-making, particularly in areas with high levels of meteorological variability. Moreover, while SAWS weather alerts reached most governmental role-players involved in responding to flooding, the study suggests that information did not always reach populations in high-risk areas.

Emergency response and relief

- The findings underline the high levels of committed, experienced practitioners skilled in managing complex events in the Western Cape. The response in both Eden and Cape Winelands District Municipality benefitted from experience honed by repeated severe weather and other events. The snow in Beaufort West presented a new challenge for disaster managers in the Central Karoo District Municipality, but they too were able to draw on experience and well-established relationships. Given the importance of this experience and these relationships, it is essential that this knowledge is formalized and serves to deepen institutional memory within disaster management authorities.
- Risk reduction and disaster response have also benefitted from improved coordination amongst a range of role-players, at multiple scales. Coordination successes extend to less standard emergencies, such as the snow in Beaufort West, which featured collaboration between a range of public, private and non-governmental role-players, and efforts to rescue the ambulance driver washed into the Cogmanskloof River in Montagu.

- The research nonetheless highlights important challenges. In Central Karoo District Municipality, weaknesses in coordination between disaster management centres resulted in the oversupply of relief items, while in the Cape Winelands there was initially limited communication between Disaster Management Operational Centre (DMOC) coordinating the response and role-players involved in providing relief. In Plettenberg Bay, residents affected by the overtopping of the Keurbooms River reported that they received limited assistance when their homes flooded.

3.4 Recommendations

3.4.1 Risk reduction and building resilience

Recommendations to national, provincial and municipal government

- Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. Resilience planning and funding mechanisms should be prioritised for high-risk areas.
- The design parameters of new infrastructure should be assessed to ensure that they are appropriate for current and future conditions.
- Funding processes need to facilitate the timely release of funding in order to support risk reduction imperatives, particularly in less-resourced local municipalities.
- There needs to be greater emphasis on mitigation in the repair of damaged infrastructure following HIWE. Rehabilitation projects must “build-back better”, with a view to strengthening infrastructural resilience to flooding.

Recommendations to national, provincial and municipal authorities

- Sedimentation levels in flood-prone areas should be assessed and addressed on an ongoing basis. Assessments should consider the capacity for bridges and culverts carrying regional and district roads over river channels given sediment accumulation.
- There is a need for greater oversight of alien clearing processes, to ensure that cleared vegetation is removed properly from the riparian zone, as specified in DWS policy.

3.4.2 Early warning

Recommendations to national and provincial government

- Gaps in weather radar coverage should be urgently addressed, especially for the Province's inland areas. This will also enable the SAFFGS to function protectively.

Recommendations to SAWS and the WCDMC

- SAWS should explore available means of refining forecasts to provide finer-scale information that captures meteorological variability between areas.
- SAWS and disaster management authorities should work together to strengthen capacity to interpret forecast information at the local level, to fine-tune pre-emptive responses.

Recommendations to municipal authorities

- Disaster management authorities should explore dissemination mechanisms that target more effectively populations in areas exposed to flooding. In Eden District Municipality, this should include communities living along the Keurbooms River and tourists and others likely to travel through flooding hotspots such as Meiringspoort.

3.4.3 Building institutional memory

Recommendations to the WCDMC

- The WCDMC needs to work with district and local disaster management authorities to identify and implement measures to deepen institutional memory, in order to build more robust disaster management capacity, particularly at the district and local level.

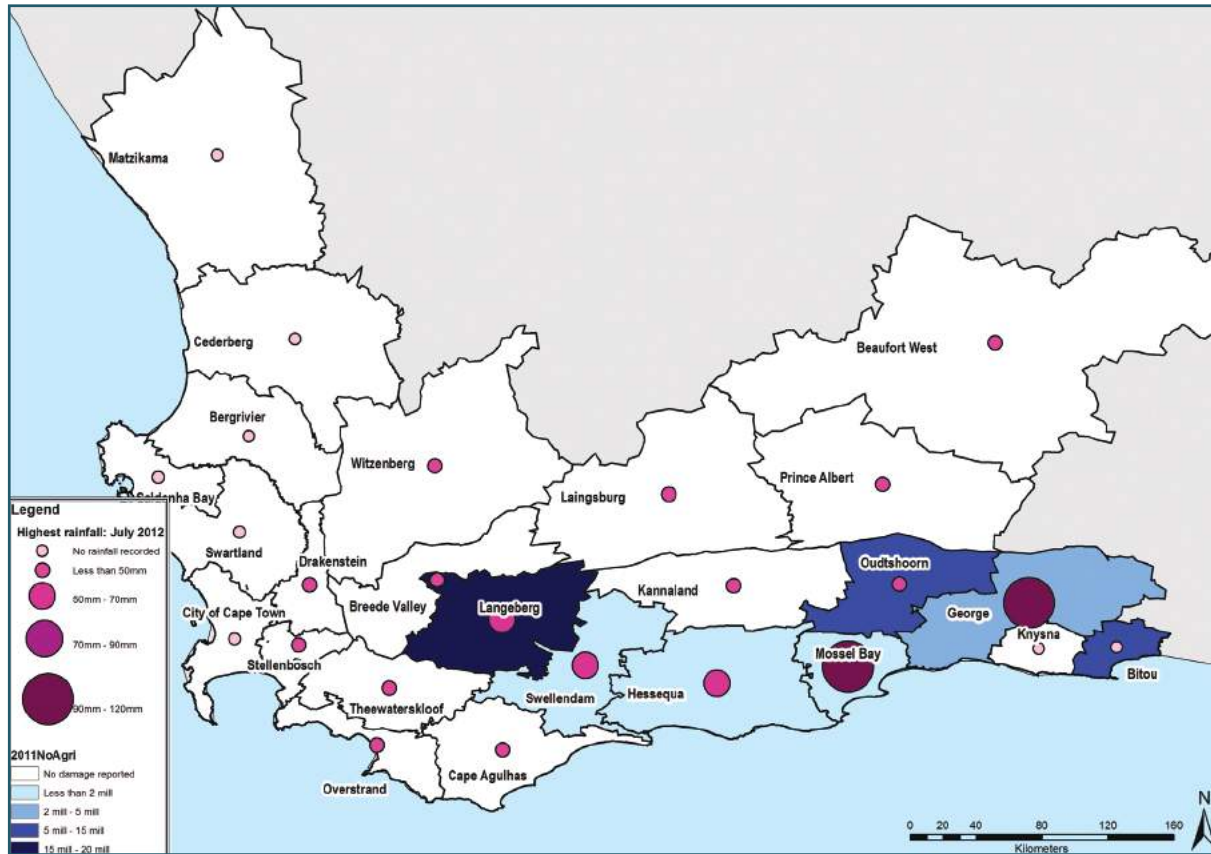


Figure 2: The rainfall and direct financial impacts for the July 2012 event (excluding Agriculture cost)

Table 3: July-August 2012 compound HIWE

Date First event Second event	13 – 14 July 2012 7 – 9 August 2012
Areas affected First event Second event	Flooding, primarily in the Eden District Municipality. Heavy snow in Central Karoo District Municipality Cape Winelands and Overberg District Municipality
Total heaviest rainfall First event Second event	George, 111.5 mm George, 131 mm
Social impact First event Second event	316 people evacuated from informal settlements in Eden. Homes and sewerage station flooding in Poortjies, in Plenttenberg Bay. Knysna Oyster Festival and Marathon cancelled. Three deaths. Approximately 200 vehicles and 5 buses trapped in snow on the N1 near Beaufort West. 7 farms cut-off. Approximately 1,400 people evacuated and/or provided with relief in Ashton, McGregor and Montagu. Montagu Springs Resort flooded. R62 through the Cogmanskloof Pass closed temporarily. One fatality.
Direct financial costs*	R51 499 204 million for both events, excluding agriculture R425 032 204, including river protection work by the DoA
Key findings Ageing infrastructure, inadequate human and financial resources, and a reliance on disaster funding contribute to flood-risk.	<ul style="list-style-type: none"> • Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. Resilience planning and funding mechanisms should be prioritised for high-risk areas. • The design parameters of new infrastructure should be assessed to ensure that they are appropriate to current and future conditions. • Funding processes must facilitate the timely release of funding in order to support risk reduction imperatives. • Rehabilitation projects must “build-back better”, with a view to strengthening infrastructural resilience to flooding.
River management contributes to flood-risk in many areas	<ul style="list-style-type: none"> • Sedimentation must be monitored and addressed • There needs to be greater oversight of alien clearing processes, to ensure that cleared vegetation is removed properly.
Forecasting in the province’s interior is challenging and warnings lack precision to inform decision-making	<ul style="list-style-type: none"> • Gaps in weather radar coverage should be urgently addressed, especially for the Province's inland areas. • SAWS should explore available means of refining forecasts to provide finer-scale information that captures meteorological variability between areas. • SAWS and disaster management authorities should work together to strengthen the capacity to interpret forecast information at the local level, with a view to fine-tuning pre-emptive responses.
Knowledge and relationships should be formalised and serve to deepen institutional memory	<ul style="list-style-type: none"> • The WCDMC needs to work with district and local disaster management authorities to identify and implement measures to deepen institutional memory, in order to build more robust disaster management capacity.

***These values differ to those reported in the Synthesis Report as they were not adjusted for inflation.**

4. HIGH IMPACT WEATHER EVENT SUMMARY

REPORT No. 3: 15-17 NOVEMBER 2013

Between 15 and 17 November 2013, much of the Western Cape experienced intense rainfall, and strong winds in some areas. The storm resulted from a combination of weather systems: a COL, which developed to the west of Cape Town, and a low-level low powered by tropically sourced moisture. The COL remained almost stationary on 15 and 16 November, increasing the potential for flooding.

The Cape Town Metro, Overberg and Cape Winelands District Municipalities were most affected, with many stations recording record rain levels. Cape Town received well over 100 mm of rain over the two-day period; nearly 200 mm of rain fell in just three hours in the Lourens River catchment. Parts of Overberg and Cape Winelands District Municipality recorded more than 200 mm of rainfall. The rainfall was the heaviest of the four events considered in the post-event assessments, and resulted in high river flows, particularly in the Lourens River in Somerset West, the Palmiet River near Betty's Bay and the Eerste River in Stellenbosch.

4.1 The event's impact

High-profile impacts included extensive flooding in Somerset West, which resulted in the evacuation of the Mediclinic Vergelegen, landslides on Chapman's Peak Drive, and the failure of the Stettynskloof water pipeline, which supplies drinking water to Worcester. In the Cape Town Metro, the mudslide above Chapman's Peak carried mud, debris and rocks into an apartment complex below, requiring evacuation of the building. More than 18 000 people were evacuated or required relief due to the flooding. Hout Bay was partially isolated due to road closures; while emergency personnel could reach the area, roads were closed to the public.

The evacuation of the Mediclinic Vergelegen represented the first recorded evacuation of an entire hospital on the continent. In just five hours, all 121 patients were transferred to other hospitals in Cape Town, Somerset West and Stellenbosch. The complex operation was coordinated by the province's EMS and involved diverse actors, from disaster management to neighbourhood watches and the National Sea Rescue Institute (NSRI). Social media, such as Twitter and Facebook played an important role in shaping the response to the flooding at the Mediclinic Vergelegen, representing another first for the authorities.

The research identified systemic drivers mediating flood-risk in the Province. The findings suggest that development is increasing flood risk throughout the Province. Urban expansion has changed catchment conditions, increasing run-off during intense rain, and placed people, buildings and infrastructure in harm's way. In Lourens River Catchment, above Somerset West, changing agricultural practices and vegetation fires also appear to have increased run-off during the 2013 event, while landcover changes may have contributed to the landslide above Chapman's Peak Drive.

4.2 Financial losses sustained

Provincial and municipal authorities in the Western Cape reported losses exceeding R 118 million (excluding damages reported by farmers). Adding the costs reported by the DoA almost doubles the total losses from R 118 million to R 205 million (these values differ to those reported in the Synthesis Report as they were not adjusted for inflation). The Cape Town Metro reported substantial costs, along with Theewaterskloof in the Overberg District Municipality and Breede Valley in the Cape Winelands District Municipality, which cumulatively incurred costs exceeding R 20 million. With the exception of Hessequa,

municipalities in Eden generally sustained only provincial damage, along with Witzenberg and Langeberg in the Cape Winelands District Municipality. The other affected municipalities reported damage to both provincial and municipal infrastructure.

4.3 Key features of the institutional response

Prevention, planning and early warning

- The included had novel dimensions, including the evacuation of the Mediclinic Vergelegen and the failure of the Stettynskloof pipeline. Responses were commendably successful overall, but the findings suggest insufficient preparedness for these more unusual types of event. The province's EMS and other medical role-players were able to draw on Major Incident Management and Support (MIMMS) training during the evacuation of the Mediclinic Vergelegen, other aspects were reactive rather than proactive, suggesting a need for plans and protocols to strengthen and streamline future responses to comparable events.

Emergency response and relief

- The storm was unusually intense and fast moving, placing disaster management and other responders under considerable pressure. In this context, the findings foreground the importance of responsiveness in establishing coordinating mechanisms and marshalling resources in rapid-fire events.
- Communication and coordination between institutional responders proved challenging in some instances. In the Cape Town Metro, communication and coordination sometimes proved challenging during the evacuation of the Mediclinic Vergelegen, foregrounding a need to strengthen communication between disaster management, frontline responders and SAWS.
- The evacuation of the Mediclinic was remarkably successful given the unexpectedness of the event. This success appears in large due to systematic and repeated training, excellent working relationships and cross-organisational collaboration and access to high levels of medical expertise in the province.
- The arrival of large numbers of members of the public to assist increased the complexity of the evacuation, as they made communication and coordination more difficult. The mobilisation of these volunteers can be traced to discussions of the event on social media platforms such as Twitter.

Role of social media in shaping the response

- Social media, in this case Twitter, played a prominent role in the event, with a small number of influential users powerfully shaping the response, particularly with respect to the evacuation of the Mediclinic, where fewer than five original Tweets encouraged self-dispatching by members of the public.
- The influence of social media in the evacuation suggests that social media is likely to comprise an increasingly powerful dynamic in responses to disaster events, and must be considered in planning and implementing response measures. The response environment has changed, and disaster management and other actors will need to engage with the public in new ways moving forward.
- Cape Town's disaster risk management centre (DRMC) did engage, and posted Tweets on behalf of the City authorities. The @cityofct account achieved some visibility during the event, but other users attracted more of a following and had greater influence, suggesting that Metro authorities (and those elsewhere) need to explore ways of raising their profile on social media platforms. The emphasis should be value and timing of the tweets.

4.4 Recommendations

4.4.1 Risk reduction and building resilience

Recommendations to national, provincial and municipal government

- There needs to be greater emphasis on prospective risk reduction. Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. Resilience planning and funding mechanisms should be prioritised for high-risk areas.
- New infrastructure needs to be designed to withstand current risk conditions, as well as a possible up-trend in both extreme weather events and climate variability in the future. Design parameters should be assessed to ensure that they are appropriate to current and future conditions.
- There needs to be greater emphasis on mitigation in the repair of damaged infrastructure following severe-weather events. Rehabilitation projects must “build-back better”, with a view to strengthening infrastructural resilience to flooding.

4.4.2 Contingency planning (general)

Recommendations to national, provincial and municipal government

- Municipalities need to work with disaster management to identify critical facilities and infrastructure exposed to flooding, as well as areas at risk of isolation during flood events, such as Hout Bay. Contingency plans need to be established to assist in strengthening and streamlining future responses to flooding in these localities.

Recommendations to the WCDMC and municipal disaster management

- Neighbourhood Watches and similar institutions could serve as a resource. Planning processes should identify local capacity and engage with a view to strengthening planning and response.
- Provincial and municipal authorities should also explore ways of increasing the responsiveness in the case of intense, rapid onset and fast moving weather events.
- Roles and responsibilities in the case of health facilities need to be clarified. EMS is mandated and best placed to manage responses concerning health facilities, but the respective roles, and chains of command stemming from a more decentralised management approach must be identified and planned for.

4.4.3 Contingency planning (health facilities)

Recommendations to national, provincial and municipal government

- The event highlights an urgent need for pre-emptive risk assessment and reduction to avoid a repeat of the 2013 event. Provincial EMS should consider and investigate the scope for making flood-risk assessment a requirement for hospitals.

Recommendations for potentially exposed medical facilities

- Senior managers in the emergency services should be sensitised to environmental and climate conditions that stand to create unexpected emergencies.
- The Mediclinic group, as well as managers of health care facilities in areas potentially exposed to flooding, should undertake risk assessments to inform appropriate mitigation and planning.
- The Mediclinic Vergelegen, and hospitals facing similar challenges, should develop evacuation protocols that establish criteria for proactive action and decision-making. These should be based on a strengthened relationship between disaster management authorities and provincial EMS.
- Planning and preparedness should anticipate communication and electricity failures.

4.4.4 Early warning

Recommendations to SAWS

- SAWS should explore available means of refining forecasts to provide finer-scale information that captures meteorological variability between areas.
- SAWS and disaster management authorities should work together to strengthen the capacity to interpret forecast information at the local level, with a view to fine-tuning pre-emptive responses.

4.4.5 Social media

Recommendations to the WCDMC and municipal disaster management

- Disaster management and other authorities must participate in social media platforms. Social media should be systematically incorporated into awareness and flood risk communication strategies.
- The WCDMC should establish a social media platform to provide information and engage the public. Municipal disaster management authorities should also develop social media communication strategies and capacity. If possible, dedicated, trained personnel should be made available to disseminate information, respond to queries and manage public interest.
- Efforts by the WCDMC to engage social media should seek to complement rather than duplicate local-level engagement by disaster management and municipal authorities, and must be coordinated between entities to ensure consistent, messaging and a unified social media presence.
- Institutions should tap the opportunities presented by influential users to raise the profile and reach of information. The emphasis must be on messaging that will help people to make improved decisions.

4.4.6 Addressing vulnerability in the agricultural sector

Recommendations to the DoA and national government

The costs to the agricultural sector suggest a need for measures to reduce flood-risk in farming areas. These should include river protection and support for improved and holistic system-level river management processes.

- Government should explore the establishment of a contingency fund aimed at expediting risk mitigation and the provision of relief to farming communities affected by disasters.

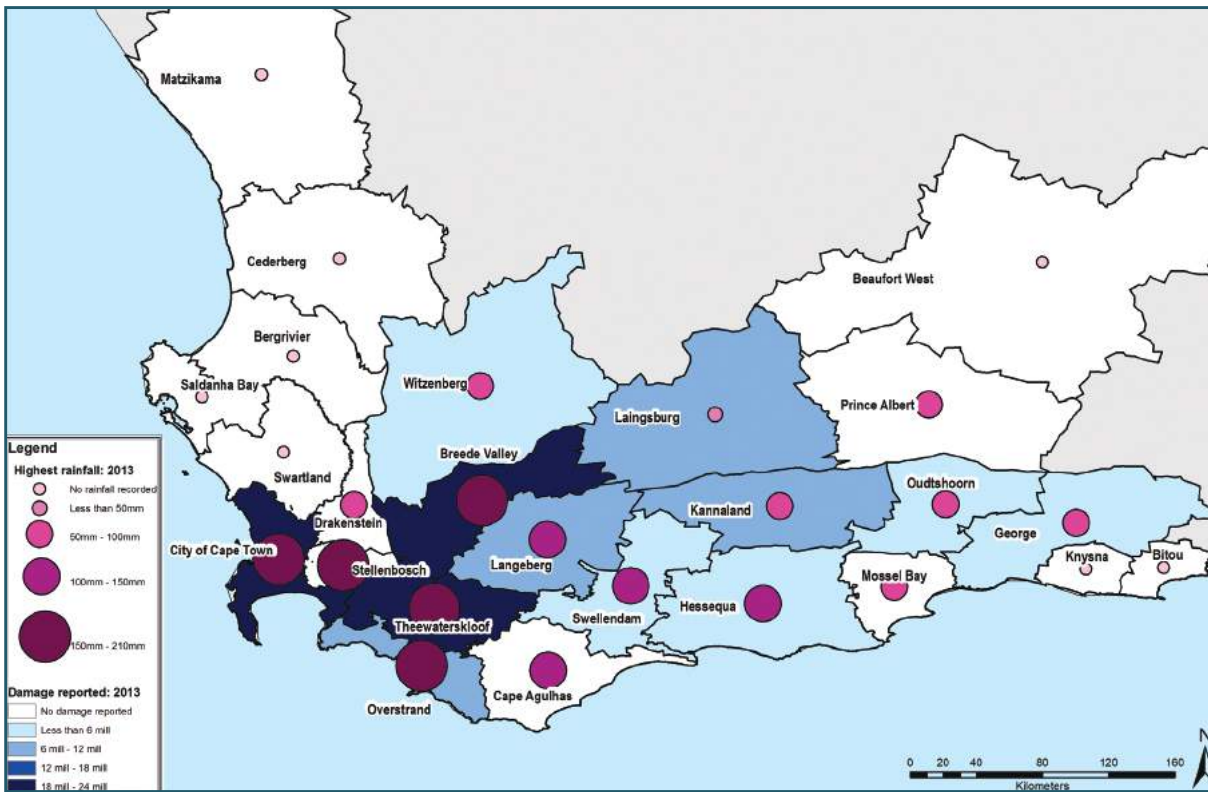


Figure 3: The rainfall and direct financial impacts for the November 2013 event

Table 4: Summary of November 2013 HIWE

Date	15 – 17 November 2013
Areas affected	Primarily City of Cape Town, Cape Winelands, Overberg District Municipalities, Central Karoo and Eden District Municipalities
Total heaviest rainfall	Theewaterskloof, 231.4 mm
Social impact	<ul style="list-style-type: none"> • In Cape Town, 221 patients evacuated from Mediclinic Vergelegen; mudflow into apartment complex below Chapman’s Peak Drive; more than 18 000 evacuated due to flooding. • Other municipalities saw extensive road closures; informal settlements flooded, farms & communities cut-off. Two fatalities.
Direct damage costs*	R 167.5 million, excluding costs to farmers R 199.8 million, including costs to farmers
Key Findings Development, agricultural practices and vegetation fires may have increased run-off during the 2013 event; Landcover changes may have contributed to the landslide.	<ul style="list-style-type: none"> • Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. Resilience planning and funding mechanisms should be prioritised. • New infrastructure needs to be designed to withstand current risk conditions. • Rehabilitation projects must build-back better, with a view to strengthening infrastructural resilience to flooding. • Critical facilities and infrastructure exposed to flooding, and areas at risk of isolation need to be identified and flood-risk contingency plans established.
There is a need for plans and protocols to strengthen and streamline future responses to similar events.	<ul style="list-style-type: none"> • Planning processes should identify and engage local response capacities. • Authorities should explore ways of increasing the responsiveness during intense, rapid onset and fast moving. • Roles and responsibilities in the case of response affecting health facilities need to be clarified. • Provincial EMS should consider and investigate the scope for making flood-risk assessment a requirement for hospitals. • Senior managers in the emergency services should be sensitised to environmental and climate conditions that stand to create unexpected emergencies. • Health care facilities potentially exposed to flooding, should undertake flood-risk risk assessments and develop evacuation protocols. • Planning and preparedness should anticipate communication and electricity failures.
Weather warnings are often too generic.	<ul style="list-style-type: none"> • SAWS should explore available means of refining forecasts to capture meteorological variability between areas. • SAWS and disaster management authorities should work together to strengthen the capacity to interpret forecast information at the local level.
Social media is shaping the way the public understands and responds to events.	<ul style="list-style-type: none"> • Social media should be systematically incorporated into awareness and flood-risk communication strategies. • Dedicated, trained personnel should be made available to disseminate information, respond to queries and manage public interest. • Efforts by the WCDMC to engage social media should seek to complement rather than duplicate local-level engagement.
Severe-weather events are placing pressure on the agricultural sector	<ul style="list-style-type: none"> • There is a need for measures to reduce flood-risk in farming areas, including river protection and support for improved and holistic system-level river management processes. • Government should explore the establishment of a contingency fund aimed at expediting risk mitigation and the provision of relief to farming communities affected by disasters.

* These values differ to those reported in the Synthesis Report as they were not adjusted for inflation)

5. HIGH IMPACT WEATHER EVENT SUMMARY

REPORT No. 4: 6 -10 JANUARY 2014

Between 6-10 January 2014, a COL weather system combined with a tropical low-pressure system to produce heavy rainfall across the Western Cape. Rainfall was especially heavy over the Central Karoo District Municipality, parts of Eden District Municipality and the Overberg District Municipality, although the weather station on the Vergelegen Wine Estate in Somerset West recorded the highest cumulative rainfall levels (389.2 mm). Rainfall levels for the January event were amongst the highest since 1983, with several stations recording cumulative rainfall in excess of 250 mm. Rivers in Kannaland Municipality saw record flows.

5.1 The event's impacts

In Laingsburg, in the Central Karoo, the Buffels, Wilgehout and Baviaans rivers flooded. Several farms immediately below the Floriskraal Dam experienced severe flooding - although the volume of water flowing over the spillway at the Floriskraal Dam was substantially lower than recorded during the historic flood in 1981, which killed 104 people. Fresh water supply and sewage pipes in Laingsburg were washed away, and the N1 was flooded. In Langeberg Municipality in the Cape Winelands District Municipality, four people drowned, while in Kannaland, 33 people were trapped in Meiringspoort and required rescuing by helicopter.

The research suggests that a range of systemic and structural challenges mediate the risk of and impact of floods. Funding constraints and inadequate human and financial resources contribute to flood-risk, particularly in smaller municipalities, with many arguing that the amalgamation of smaller municipalities into larger ones has compromised risk reduction. Other sources of risk include the encroachment of croplands into riverine areas and development in floodplains; river management, including challenges with respect to alien clearing projects, and disjointed often illegal river works; and dam management and safety concerns. Sediment accumulation in riverbeds and in dams compromises both bridges and the ameliorating function of dams, and underlies much of the damage sustained during flood events.

National, provincial and municipal authorities reported direct financial losses of R 275.4 million (excluding agricultural costs). Including damages reported by the DoA, more than doubles the cumulative losses to R 586.4 million, with 39% of agricultural losses sustained by farmers located in the Eden District Municipality (these values differ to those reported in the Synthesis Report as they were not adjusted for inflation). Losses were highest in Laingsburg (R 110.2 million) and Hessequa Municipality (R 90.6 million). Provincial government sustained losses of nearly R 490 million, with the DoA, DTPW and the Department of Environmental Affairs (DEA) reporting the highest costs. Municipal damages were highest in Hessequa Municipality, followed by George and Mossel Bay Municipality, and reflect primarily damage to roads and storm-water drainage systems. The research also suggests substantial, unrecorded losses to farmers and the agricultural sector, and growing precariousness of agricultural livelihoods.

5.2 Key features of the institutional response

5.2.1 Prevention, planning and early warning

- As with the other events, mitigation measures undertaken by municipalities may have served to mitigate the occurrence and impact of flooding. These include upgrading storm-water infrastructure, strict land-use by-laws, alien vegetation clearing and improved river management, as well as structural measures such as building berms in high-risk areas.

- The findings suggest weaknesses in early warning. Forecasts initially failed to forecast storms for the Central Karoo District Municipality, affording local authorities less time to prepare for the storm. This gap in forecasting is at least partly linked to inadequate weather radar capacity, which severely constrains accurate forecasting and warning for the Province’s interior. The generalised nature of warnings remains a challenge, while the findings suggest that more could be done to reach members of the public and tourists regarding flash flooding in known hotspots, such as Meiringspoort.

5.2.2 Emergency response and relief

- The response benefitted from experience and relationships honed by repeated severe weather and other events. This knowledge and these relationships need to be formalized and must serve to deepen institutional memory within disaster management authorities.
- However, capacity constraints are a challenge in some areas. Many municipalities have few disaster and emergency response personnel, and some areas responses may be hampered by shortages of vehicles and equipment. Capacity issues also constrain the responsive provision of relief, although South African Social Security Agency (SASSA) is increasingly strengthening relief capabilities in the province. Bureaucratic processes also slow the provision of relief.
- In Laingsburg, telephone and cell phone networks were affected, making it harder to communicate and coordinate activities, indicating a need for back-up communication systems.

5.3 Recommendations

5.3.1 Risk reduction and building resilience

Recommendations to national, provincial and municipal government

- Flood-risk should be explicitly incorporated into planning, infrastructural developments and maintenance regimes. Resilience planning and funding mechanisms should be prioritised for high-risk areas.
- New infrastructure needs to be designed to withstand current risk conditions, as well as a possible up-trend in both extreme weather events and climate variability in the future.
- Rehabilitation projects must “build-back better”, with a view to strengthening infrastructural resilience to flooding.
- The costs to the agricultural sector suggest that government should explore the establishment of a contingency fund aimed at expediting risk mitigation and the provision of relief to farming communities affected by disasters.

5.3.2 Building capacity

Recommendations to national and provincial government and the WCDMC

- In keeping with a broader emphasis on resilience-building, there is a need to boost capacity in municipalities and local disaster management authorities, particularly in smaller municipalities.
- Local and provincial authorities should urgently address gaps in the provisioning of emergency response vehicles, particularly in flood-prone areas such as Langeberg Municipality. Emergency response capabilities in these areas also need to be enhanced.
- The WCDMC needs to work with district and local disaster management authorities to identify and implement measures to deepen institutional memory, in order to build more robust disaster management capacity at the district and local level.

5.3.3 Addressing vulnerability in the agricultural sector

Recommendations to the DoA and national government

- The costs to the agricultural sector suggest a need for measures to reduce flood-risk in farming areas. These should include river protection and support for improved and holistic system-level river management processes.
- Government should explore the establishment of a contingency fund aimed at expediting risk mitigation and the provision of relief to farming communities affected by disasters.

5.3.4 River and dam management

Recommendations to national, provincial and municipal government

- Sedimentation levels in flood-prone areas should be assessed and addressed on an ongoing basis. Assessments should consider the capacity for bridges and culverts carrying regional and district roads given sediment accumulation.
- The DWS should evaluate the progress of rectification processes aimed at reducing the safety risks at various large and medium dams, particularly in the Karoo where sediment loading and retention is high. Where progress is slow or delayed, increases in vulnerability downstream must be identified and communicated to the affected parties.
- The DoA should work with farmers to reduce the sediment yield in farming areas by encouraging and deepening improved farming and land care practices.
- There needs to be greater oversight of alien clearing processes, to ensure that cleared vegetation is removed properly from the riparian zone, as specified in DWS policy.

5.3.5 Early warning

Recommendations to national and provincial government

- Gaps in weather radar coverage should be urgently addressed, especially for the Province's inland areas. This will also enable the SAFFGS to function protectively.

Recommendations to SAWS and the WCDMC

- SAWS should explore available means of refining forecasts to provide finer-scale information that captures meteorological variability between areas.
- SAWS and disaster management authorities should work together to strengthen the capacity to interpret forecast information at the local level, with a view to fine-tuning pre-emptive responses.
- The WCDMC should work with SAWS and municipal authorities to identify and monitor hotspots, such as Meringspoort. Intense rainfall upstream of exposed and vulnerable areas should activate immediate actions by local emergency services, including the closure of routes regularly affected by flooding.

Recommendations to municipal authorities

- Disaster management authorities should explore ways of disseminating warnings and other information to the public and tourists regarding flash flooding in known hotspots such as Meiringspoort. These could include alerting tourist bureaus and information centres and key accommodation providers, as well as broadcasts on local and provincial radio stations.

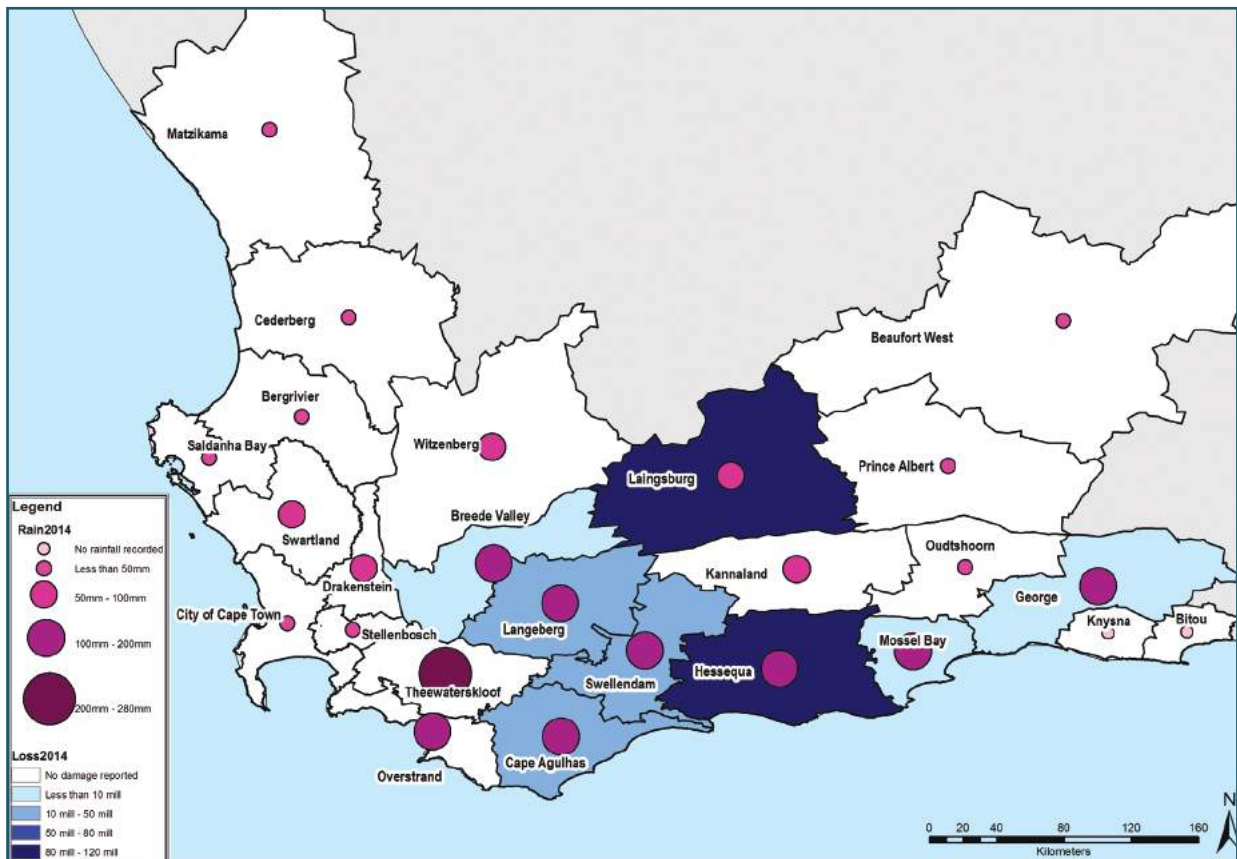


Figure 4: The rainfall and direct financial impacts for the January 2014 event

Table 5: Summary of the January 2014 HIWE

Date	6 – 10 January 2014
Areas affected	Most of the Western Cape, but particularly in the Cape Winelands, Central Karoo, Overberg and Eden District Municipalities
Total heaviest rainfall	Somerset West, 389.2 mm
Social impact	Water supply and sewage pipes in Laingsburg were washed away, and the N1 was flooded. Four fatalities in Langeberg Municipality, and 33 people trapped in Meiringspoort, in Kannaland Municipality
Direct damage costs*	R 275.4 million excluding costs to farmers R 586.4 million including agriculture
Forecasting in the Province's interior is challenging and warnings lack precision to inform decision-making	<ul style="list-style-type: none"> • Gaps in weather radar coverage should be urgently addressed, especially for the Province's inland areas. • SAWS should explore available means of refining forecasts to provide finer-scale information that captures meteorological variability between areas. • SAWS and disaster management authorities should work together to strengthen the capacity to interpret forecast information at the local level. • The WCDMC should work with SAWS and municipal authorities to identify and monitor hotspots; intense rainfall upstream should trigger immediate action. • Disaster management authorities should explore ways of disseminating warnings and other information to the public and tourists regarding flash flooding in known hotspots such as Meiringspoort.

<p>Inadequate human capacity, vehicles and equipment hamper response in some areas</p>	<ul style="list-style-type: none"> • Human capacity needs to be strengthened, particularly in smaller municipalities. • Local and provincial authorities should urgently address gaps in the provisioning of emergency response vehicles in flood-prone areas, and enhance emergency response capabilities. • The WCDMC needs to work with district and local disaster management officials to identify and implement measures to deepen institutional memory at the district and local level.
<p>HIWE are placing pressure on the agricultural sector</p>	<ul style="list-style-type: none"> • The DoA should continue to support river protection measures and improved and holistic system-level river management processes. • Government should explore the establishment of a contingency fund aimed at expediting risk mitigation and the provision of relief to farming communities

***These values differ to those reported in the Synthesis Report as they were not adjusted for inflation**