

**“Sometimes I Think the Shack was Better”:
Examining Flood-Risk in Subsidised Housing
Areas in Cape Town**

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Abstract

Flooding is an ongoing challenge in Cape Town. The problem is considered most severe on the Cape Flats, where thousands of poor households are affected by seasonal flooding each year. Informal settlements are perceived to be most vulnerable. The authorities, the research community and those living in flood-prone informal settlements view the provision of state-subsidised housing as the definitive, long-term solution to flooding on the Cape Flats. This relationship between housing and risk reduction rests on the pervasive, but entirely untested, assumption that flooding is confined to informal settlements. However, the combination of well-documented quality concerns and the geographical and social marginality of developments makes a strong case for flooding in subsidised housing areas.

This thesis examines the extent, nature and impact of flooding in informal and subsidised housing areas on the Cape Flats. Drawing on constructivist arguments regarding the subjectivity of risk as a concept, I examine how flooding and risk are conceptualised locally and internationally, and how well these framings compare with people's experiences in subsidised housing areas in Cape Town. I show that flooding remains a significant challenge in subsidised housing areas. Flood-risk has a strong built environment component; the very dwellings that should help to improve people's lives serve instead to transform and perpetuate risk, undermining the developmental objectives of the housing programme. In so doing, I interrogate assumptions about risk, hazard and vulnerability, and the lessons for theory and practice.

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List of acronyms

BNG	Breaking New Ground strategy
CTCHC	Cape Town Community Housing Company
DiMP	Disaster Mitigation for Sustainable Livelihoods Programme
DRMC	Disaster Risk Management Centre
ePHP	Enhanced People's Housing Process
FEDUP	Federation for the Urban Poor
GIS	Geographic Information System
GPS	Global positioning system
IPCC	Inter-governmental Panel on Climate Change
iSLP	Integrated Serviced Land Project
NBR	National Building Regulations
NHBRC	National Home Builders Registration Council
NGO	Non-governmental organisation
PAR	Pressure and Release model
PHP	People's Housing Process
SCCPA	Southern Coastal Condensation Problem Area
SPSS	Statistical Package for the Social Sciences
UISP	Upgrading of Informal Settlements Programme

CHAPTER 1

Exploring the Construction of Flood-Risk

Introduction

Flooding is a perennial problem in Cape Town. Heavy winter rainfall frequently results in flooding between May and September. An assessment carried out in 2004, for instance, shows that there were 24 significant flood events in Cape Town between 1989 and 2004 (DiMP, 2005). More recent estimates suggest that between 32 000 and 34 000 people were displaced by flooding in informal settlements each year during the winters of 2007, 2008 and 2009 (Wood 2009, cited in Ziervogel and Smit, 2009).¹ This flooding seldom claims lives, but results in significant damage to property, roads and infrastructure. It is estimated that major flooding in August 2004 alone cost the City at least R 6.5 million in direct, quantifiable losses and its citizens untold indirect losses (DiMP, 2004). ‘Rising flooding’ due to the high water table in some areas is a particular concern. Others include flooding as a result of urban sprawl into wetlands and other flood-prone areas.

Practitioners, researchers and communities make a range of assumptions about flooding in Cape Town. It is widely believed that flooding is most common, and its impact most severe, in the city’s more than 200 informal settlements, particularly on the City’s impoverished Cape Flats (see for instance, Drivdal, 2011 a-b; DiMP, 2009a-c; Ziervogel and Smit, 2009; Bahry, 2007; Bouchard et al, 2007; DiMP, 2004), a sandy, inhospitable plain on the outskirts of the City known for its exposure to the elements. Few explicitly link the provision of state-subsidised formal housing with

¹ Informal settlements refer to settlements that fall outside of the government’s planning processes. Unlike formal settlements, which are characterised by formal site planning and service infrastructure, informal areas are entirely unplanned and have little or no infrastructure. As used in South Africa, the term is analogous to ‘shanty-towns’. Informal settlements are technically illegal, but residents are protected by legislation granting them *de facto* tenure rights by virtue of living on the land. They have tended to be un-serviced spaces, but where they are located on government-owned land, the authorities increasingly provide basic services, including communal toilets and tap and refuse collection from communal tips. Informal dwellings tend to be rudimentary, makeshift structures, and are often built using combinations of corrugated iron, plastic and wood.

the reduction of flood risk; but the provision of housing is viewed as a cure-all for a range of developmental challenges in the City, including flooding. Both the authorities and researchers view the provision of housing as the definitive solution to the reduction of risk. People living in informal settlements also view housing as a remedy for flooding, and regularly call on government to provide them with dwellings.

This relationship between housing and risk reduction rests on the widely held, but entirely untested, assumption that flooding is confined to informal settlements. The quote in the title of this thesis, however, points to a fundamental disjuncture between practitioners, researchers and communities' perceptions of risk, and people's experiences in subsidised housing areas. Spoken by a participant during a focus group discussion in aptly named Better Life, a subsidised housing development on the Cape Flats, the statement "sometimes I think the shack was better" speaks to continued flooding in formal housing areas. This statement calls into question the assumptions that frame research and policy work on flooding in Cape Town and in parallel contexts across the developing world. Households in Better Life not only continued to experience problems when it rained, but in just three years, mould and damp in brand new homes had made some dwellings uninhabitable. These outcomes had a strong built environment component; the very dwellings that should have helped to improve households' lives served instead to perpetuate risk. This thesis explores this disconnect between how flooding and its solutions are conceptualised and the reality in subsidised housing areas. In so doing, it examines assumptions about risk in prevailing theory, research and practice, and how these compare with people's experiences in subsidised housing areas.

Drawing on constructivist arguments regarding the subjectivity of risk as a concept, the thesis interrogates the construction of risk broadly and flood-risk specifically. I use flooding in subsidised housing areas on the Cape Flats as a case study to explore how risk is conceptualised in the international and South African literature on flooding and urban risk, and evaluate how well these framings of risk capture the experience of households in poor areas in Cape Town. Drawing on qualitative, survey and spatial data from five subsidised housing developments and five informal settlements, my research examines how the construction and experience of flood-risk compare, and considers the lessons suggested for theory and practice.

Interpreting reality: The constructionist argument

For the most part, risk is presented as an objective concept, but many argue that it is in fact subjective. Writing on disasters, Tom Horlick-Jones, for instance, argues that the “perceptions of disasters strongly reflect the preoccupations and circumstances of whoever is doing the perceiving” (1995:307). Frank Furedi (2007) makes a similar point, noting that the importance attached to events is often a matter of perception. Citing Lowell Juilliard Carr (1932), he notes, “not every windstorm, earth-tremor, or rush of water is a catastrophe” (2007:483). Annelies Heijmans (2001) makes an analogous argument with respect to vulnerability. She argues that while disaster agencies use the concept of vulnerability to analyse the various factors and processes underlying the impact of disasters on society, the definition of vulnerability depends largely on who is defining it, and is usually constructed by external actors rather than communities themselves.

The constructionist approach argues that the way we understand and describe the world is influenced by our worldview and perspective. Under the constructionist position, Tom Horlick-Jones and Jonathan Sime argue, the conceptualisation of risk is socially negotiated: “the identification and assessment of risk is both a human and a social activity and, as such, is concerned with the production of meaning and a shared understanding of reality” (Horlick-Jones and Sime, 2004:447). As Ortwin Renn notes, risks are created and selected by human actors. Writing on responses to risk and uncertainty, he argues that risk - which he defines as the potential for adverse effects due to natural events or human activities - is inherently about perception: “what counts as a risk to someone may be an act of God to someone else, or even an opportunity for a third party” (2008:2).

Relatively little of the literature on disaster risk reduction and management adopts a constructionist approach, and commentators are often critical of it. For the most part, the literature on disaster risk reduction and management adopts either what Ben Wisner and colleagues (2004) term a realist approach, or a weak constructionist

perspective. Contrary to what they call the ‘strong’ constructionist position, the ‘weak’ constructionist perspective considers risk as an objective hazard or threat that exists and can be measured independently, but is mediated through social and cultural processes. Commentators like Horlick-Jones and Sime (2004) are careful to distinguish constructionism from idealism, but the literature often conflates the two. Horlick-Jones and Sime argue that constructivism, which focuses on understanding the social processes entailed in understanding and describing the world, is different from idealism, which views the world as a construct of the mind, entirely generated through socially-organised representations, but critics often view them in much the same terms. Wisner and colleagues, for instance, argue that in the constructionist view “nothing is a risk itself, but is a contingent product of historically, socially and politically created ‘ways of seeing’” (2004:19). They dismiss it on the grounds that “strong social constructionist approaches...do not lead, in any direct way, to an improvement in practice – either in disaster prevention or in post-disaster management” (2004:19). Omar Cardona also argues that the constructionist position is impossible to apply practically. He notes:

Conceptually and pragmatically, it is very unsatisfactory to maintain a situation where each individual subjectively defines and assumes risk in their own particular way. This position is totally inoperable when intervention in risk becomes indispensable from the public policy perspective (2004:47).

The constructionist approach may indeed present difficulties for practice, but the argument raises important questions about how risk, hazard and vulnerability are conceptualised and applied. While proponents of constructionism tend to focus on how people, societies and subcultures perceive and interpret risk, and respond to disaster warnings, this thesis posits that the constructionist approach provides a useful perspective for interrogating the robustness of prevailing understandings of risk, hazard and vulnerability. Contrary to Wisner and colleagues’ assertion that constructionism contributes nothing to practice, this thesis suggests that the constructionist perspective invites useful interrogation of these concepts. It raises important questions about how risk, hazard and vulnerability are conceptualised, and how effectively current discourses on risk, historically led by commentators in the

developed world, capture the realities and experiences of at-risk communities in developing countries. The answers to these questions speak to the robustness of prevailing approaches and are immensely important for disaster risk theory and practice.

In this spirit, this thesis examines the framing of urban risk and the degree to which prevailing constructions of risk capture the experiences of people living in a contemporary urban setting in the developing world. It examines how risk, hazard and vulnerability are conceptualised in discussions on flood-risk and risk more broadly, and how these framings compare with the experiences of households living in subsidised housing in Cape Town. I do not explore or debate whether risk is an objective or subjective idea, or the relative merits of the constructionist approach compared to those approaches that conceptualise risk as a more immutable concept. Instead, I take the constructivist idea that the conceptualisation of risk in theory and practice is shaped by the worldview of contributors as a jumping-off point to examine how risk is conceptualised and applied, and how well these framings of risk fit the real-world experiences of South Africans living in subsidised housing.

The thesis specifically examines flooding that endangers human communities. Flooding is often an important and regenerative component of natural ecosystems. It can also positively underpin agricultural systems as well as other economic activities. This thesis, however, focuses on flooding that has the potential to harm people, destroy or damage property or infrastructure, and impact negatively on livelihoods. Flooding in this thesis thus refers to 'endangering flooding' only, which has the potential to impact negatively on people, their property and livelihoods.

Framing the problem

Discussions on flooding have been influenced strongly by assumptions about risk in the natural, rural environment (Zevenbergen, 2007). 'Flooding' is generally considered a hydrometeorological hazard rooted in atmospheric, hydrological and, to a lesser extent, oceanographic processes, and most emphasise its hydrological

components. Flooding is conceptualised in terms of too much water, water above a particular point such as a riverbank or channel, the inundation of land that is habitually dry, or as Keith Hewitt argues “water ‘in the wrong place’ or ‘at the wrong time’” (1997:80). In keeping with the focus on the hydrological aspects of flooding, discussions often focus on various kinds of watercourse flooding, storm surges and coastal flooding. Alexander (1993), for instance, identifies four kinds of flooding:

- riverine floods due to heavy rain or melting snow;
- estuarine floods, usually resulting from a combination of tidal surges and riverine flooding further upstream;
- coastal floods due to hurricanes, severe storms or tsunamis; and
- catastrophic events, such as dam bursts or the effects of earthquakes or volcanic eruptions.

Emerging research on flooding in urban areas in the developing world identifies additional and often unique forms. This literature suggests that urbanisation serves to amplify the effects of hazards such as heavy rainfall. The proliferation of impermeable surfaces, for instance, increases the risk of run-off and water accumulating (ponding) in paved-over and low-lying areas, while interference with natural drainage systems and aging and inadequate drainage infrastructure increase the risk of rivers and drains over-topping (Fatti and Patel, 2012; Pelling and Satterthwaite, 2007; Hewitt, 1997). This literature extends the conceptualisation of flooding from an issue of weather and hydrology to a more intimately developmental one, less rooted in natural systems. New flood-types include flooding due to urban sprawl onto floodplains (GAR, 2009), inadequate or poorly functioning drainage infrastructure and weak storm water management, and the dumping of solid waste and rubble into watercourses (Sakijege et al, 2012; Action Aid, 2006). However, the construction of the hazard remains in largely the same conceptual realm as the broader literature on flooding, in that it continues to envisage flooding in terms of too much water and links it primarily to weather.

Vulnerability to the effects of hazards is also envisaged in quite specific ways. Early work on flooding focused on its geophysical aspects, equating the likelihood of

flooding with vulnerability. However, the modern approach argues that flood-risk, and risk more generally, is the product of social, economic, environmental, demographic and governance issues. It recognises that features of society drive vulnerability, and that the drivers operate at a range of different scales. In the case of flooding, particularly in urban areas, the literature suggests that vulnerability is often linked to rapid and poorly managed urban expansion, as well as developmental challenges such as the proliferation of informal settlements and inadequate service delivery.

The literature on flooding often implies a particular vision of flooding and pathways of cause and effect. Research on urban flooding brings a more developmental perspective, but overall, flooding remains conceptualised in terms of surplus water, overflowing waterbodies, and inundation. As discussed further in Chapter 2, the progression generally runs from rain, storms or changes in weather, which result in overflowing rivers, storm surges, or other types of flooding, through a range of mediating issues such as land use patterns, the developmental context and governance dynamics, to outcomes such as flooded communities, human and financial losses, and damage to property and infrastructure.

Underlying this construction of risk is a range of assumptions about which people are vulnerable, why they are vulnerable and at what level risk manifests. The literature on urban flooding, for instance, suggests a strong link between poverty and risk (for instance, Action Aid, 2006; Pelling, 2003). The poor are viewed as most vulnerable. Those living in informal settlements are considered particularly so, where dangerous locations, substandard housing, inadequate service delivery and other developmental issues leave them particularly exposed to flooding, and amplify its impact. Vulnerability also tends to be viewed as socially constructed. It is first and foremost socio-economic and governance issues that determine how the effects of hazards are felt. While features of society may encourage and allow people to live in flimsy dwellings in areas exposed to flooding, for instance, the emphasis is on the societal dynamics structuring the risk environment.

South African discussions on flooding in urban areas, and indeed disaster risk more generally have a particularly strong focus on informal settlements. Most research

explores the nature of flooding in informal settlement areas, and prevailing framings of risk draw heavily on the challenges and dynamics in these areas (see, for instance, Drivdal, 2011a-b; Dixon and Benjamin, 2008; DiMP, 2008; DiMP, 2007; Bouchard et al, 2007; Ramutsindela, 2006). There is very little on concerns in other poor areas. This is particularly so in Cape Town, where discussions focus almost exclusively on informal settlements. The authorities, researchers and those living in flood-prone communities all assume that flooding is only a problem in informal housing. Most relevant to this thesis, they also assume that providing poor households living in informal dwellings with a brick and mortar home solves a range of risks, including flooding.

There is evidence to suggest, however, that prevailing constructions of risk fail to capture the full range of experience in urban areas. Two studies conducted in South Africa's Western Cape Province suggest that flooding is a concern in subsidised housing areas. The first, a post-flood assessment in Montagu carried out by Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) in 2003, shows that dwellings in subsidised housing areas suffered high levels of damage, including reports of walls and roofs collapsing (DiMP, 2003). The second (Benjamin, 2008) explores the hazard landscape in a flood-affected subsidised housing area in George, and showed that many households experienced flooding.²

It is against this backdrop that I interrogate the construction of risk. Taking as a case study five informal and five subsidised housing areas on the Cape Flats, I test prevailing assumptions about risk generally, and flood-risk in particular. While I aim to understand better the parameters of flood-risk in Cape Town, and contribute to the emerging literature on urban flooding, these issues serve primarily as entry-points for examining how well flood-risk in subsidised housing conforms to arguments and assumptions about risk in the literature. A secondary layer of analysis tests the assumption made in South African theory, practice and public opinion that the provision of housing addresses flood-risk. Specifically, I test the assumption that only households living in informal settlements in Cape Town experience flooding.

² Benjamin's research drew on an earlier post-flood evaluation carried out by DiMP in 2007 (DiMP, 2007).

The aims and objectives of the thesis

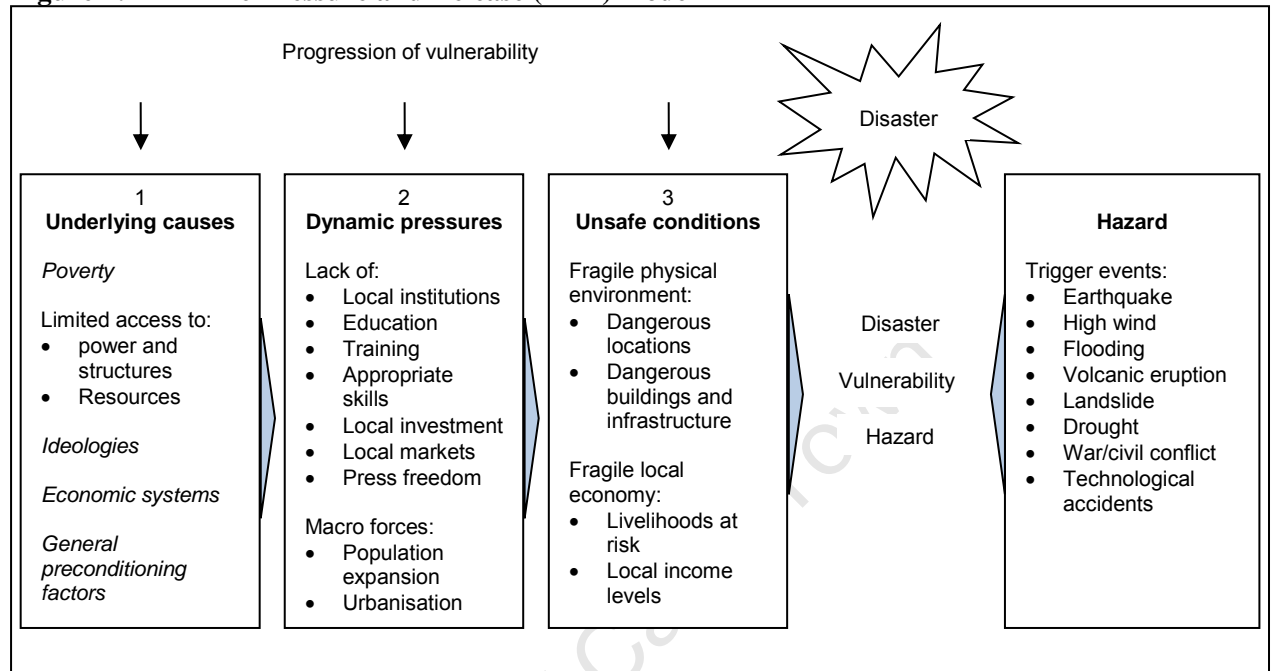
Beginning from the position that risk comprises hazard and vulnerability components, I examine how the literature constructs and locates risk, and how well prevailing conceptualisations capture people's experiences. I draw on three broad bodies of literature: prevailing thought on the nature and impact of flooding; the nature, components and parameters of disaster risk, including the literature on urban risk; and finally, research on urban flooding, particularly that emerging from African countries.

The thesis draws on political ecology approaches to understanding risk and adopts a multi-dimensional perspective. I draw broadly on theoretical contributions such as Piers Blaikie and colleagues' (1994) and Ben Wisner and colleagues' (2004) Pressure and Release (PAR) model (Figure 1). They argue that vulnerability is generated through underlying causes, dynamic pressures and unsafe conditions. Underlying causes refer to macro-level factors, such as poverty, prevailing macro-economic systems, political structures and ideologies that serve to provide some people with more power and resources than others. Dynamic pressures refer to processes, such as poor service delivery and environmental degradation, that serve to translate these root causes into unsafe conditions. These conditions are expressed in time and space - such as living in poor-quality housing or in a dangerous location - which leaves people more likely to be negatively affected by hazards. In keeping with this approach, I examine risk from a physical, socio-economic and governance perspective.

The thesis focuses on how risk, and flood-risk specifically, is presented, described, discussed and applied in the literature. I do not focus on flooding as a meteorological or hydrological issue, but rather on what the experience of flooding in subsidised housing shows about how flood-risk and risk are conceptualised. Similarly, I do not explore the precise components of risk and vulnerability. While I recognise that both risk and vulnerability are contested and extensively debated concepts, this thesis does not engage in in-depth debates about how to define them. It does not examine, for instance, whether risk should include some measure of resilience, coping or response, or whether exposure is a component of vulnerability or separate from it. Instead, it examines broadly how well 'risk' and its core components of 'hazard' and

‘vulnerability’ capture the experiences of people living on the Cape Flats, and what this suggests about the way we understand contemporary risk in developing countries.

Figure 1: The Pressure and Release (PAR) model



Source: Blaikie et al, 1994; Wisner et al, 2004

The thesis focuses on how risk, and flood-risk specifically, is presented, described, discussed and applied in the literature. I do not focus on flooding as a meteorological or hydrological issue, but rather on what the experience of flooding in subsidised housing shows about how flood-risk and risk are conceptualised. Similarly, I do not explore the precise components of risk and vulnerability. While I recognise that both risk and vulnerability are contested and extensively debated concepts, this thesis does not engage in in-depth discussions about how to define them. It does not examine, for instance, whether risk should include some measure of resilience, coping or response, or whether exposure is a component of vulnerability or separate from it. Instead, it examines broadly how well ‘risk’ and its core components of ‘hazard’ and ‘vulnerability’ capture the experiences of people living on the Cape Flats, and what this suggests about the way we understand contemporary risk in developing countries.

The thesis aims to interrogate the conceptualisation of flood-risk suggested in prevailing approaches to risk, the extent to which these capture local experiences. Drawing on qualitative, quantitative and spatial data from both informal settlements and subsidised housing areas, I examine the nature of the hazard, particularly whether endangering flooding on the Cape Flats is primarily a hydrometeorological hazard. I explore how ‘flooding’ manifests, whether endangering flooding results primarily in inundation, and whether it results in human losses and damage to property and infrastructure. Finally, I test the assumptions made in both the local and international literature concerning the drivers of vulnerability, who is most vulnerable and the scale at which risk accumulates and impacts.

Overall, the thesis seeks to compare the empirical experiences of households living in both subsidised housing and informal settlements against prevailing constructions of flood-risk, and risk more broadly. The thesis tests the overarching research question of whether the provision of subsidised housing addresses flood risk, and how the experiences of formal and informal households compare. Specifically, it examines four inter-related and overriding questions: when it comes to endangering flooding, what is it that households in flood-prone areas are vulnerable to? Who is vulnerable to flooding? What factors drive vulnerability? At what scale does risk accumulate and how is it realised? Table 1 summarises these questions and the research questions flowing from them.

As noted already, I aim to contribute to an emerging literature on urban risk generally and flood-risk specifically. Research on urban flooding has helped to deepen and nuance how flooding is conceptualised in towns and cities, but as discussed already, very few studies have explored flooding in poor, but formal areas. With this research, I intend to begin filling this gap. By exploring the nature and extent of flooding in subsidised housing areas, I aim to highlight the experiences of a largely invisible and potentially neglected constituency in South Africa. I aim to challenge assumptions about flooding in subsidised housing areas, and the nature and parameters of urban flood-risk more broadly. I also hope to provide an additional perspective to international discussions on urban flood-risk. Finally, by interrogating the construction and application of risk against lived experiences in a contemporary urban setting, I hope to contribute to the wider body of knowledge on urban risk. As for

local theory and practice, I aim to challenge the prevailing emphasis on risk in informal settlements, and motivate for a broader view that incorporates the experiences of those living in formal housing in poor areas.

Table 1: Conceptual and research questions guiding the research

Conceptual questions	Research questions
What are households vulnerable to?	<ul style="list-style-type: none"> • What types of flooding are experienced in informal and subsidised housing areas in Cape Town? • To what extent do topographic or locational factors influence households' experiences of flooding?
Who is vulnerable?	<ul style="list-style-type: none"> • How does flooding manifest? • Does flooding result in flooded dwellings and communities and damage to property and infrastructure?
What makes them vulnerable?	<ul style="list-style-type: none"> • Are households living in subsidised housing less likely to experience flooding than those in informal settlements? • Do some households experience more flooding than others or are some more impacted than others? • What makes the difference?
At what scale does vulnerability manifest?	<ul style="list-style-type: none"> • Are households in particular communities and or locations equally prone to flooding?

Overview of the thesis

My research challenges prevailing assumptions about the nature, location, drivers and impact of flood-risk. I show that flooding is not confined to informal settlements. I also show that although flooding has a hydrometeorological component, 'flooding' in subsidised housing on the Cape Flats is not about severe weather, overflowing waterbodies or storm surges. It takes, instead, the form of leaks in poorly built dwellings and results in hazardous damp and mouldy conditions rather than inundation. The research shows that although shaped by social issues, vulnerability in Cape Town has a crucial built environment component. The geographical and socio-economic marginality of the Cape Flats, and the social exclusion of the households living in informal and subsidised housing settlements on the Flats undoubtedly serve

to configure risk in the broadest sense, but more proximately, exposure and vulnerability are linked to the nature and quality of housing. It illustrates that rather than addressing flood-risk, the poor design and quality of dwellings serves to perpetuate and amplify flood-risk, and suggests that buildings need to be central to discussions on flooding in South Africa. This finding is particularly important in the context of subsidised housing, as it not only challenges fundamental assumptions about housing as a solution to risk, but also implies that flooding undermines the developmental objectives of South Africa's subsidised housing programme. Finally, the study suggests that vulnerability and risk accumulate and manifest in a highly idiosyncratic manner in subsidised housing areas. It shows substantial variation in the experience flooding both between and within settlements, and suggests that risk needs to be understood from an individualised perspective.

I argue that there is disjuncture between how risk is conceptualised in the international and domestic literature and the experiences of households living in subsidised housing. I argue that prevailing framings of flood-risk, and risk more broadly, fail to capture the full spectrum of experience in contemporary urban environments. The research also suggests, I argue, that a reliance on pre-determined categories of what flooding involves and who is vulnerable, prevents a comprehensive analysis of flood-risk. I draw on these findings to argue for a broader, but more precise conceptualisation of flood-risk, and risk in urban areas more broadly.

Chapter 2 explores the construction of flood-risk, and risk more generally, in the international literature. It examines how the concepts of risk, hazard and vulnerability are conceptualised, how the concepts relate to one another, and how they are defined. It also explores in greater detail suggested causal pathways identified in prevailing approaches to flood-risk. In particular, it explores how the literature on endangering flooding, and risk in general, constructs and locates vulnerability with respect to what and who is vulnerable, what makes them vulnerable, and the scale at which both risk and vulnerability are discussed and applied. I argue that the literature constructs risk, and flood-risk specifically, in very particular ways. In addition to constructing flooding, the hazard, in primarily hydrological terms, it often makes broad assumptions about who is most vulnerable, the factors driving vulnerability and the scale at which risk manifests. This prevents a comprehensive understanding of risk.

Chapter 3 discusses the context for the study. It also examines the aims and objectives of the South African government's subsidised housing programme, and prevailing assumptions about the role of subsidised housing in delivering development generally and addressing flood-risk specifically. In the context of well-documented quality challenges in South Africa's subsidised housing programme, it explores, in particular, the widely held assumption that the provision of a brick and mortar dwelling addresses flood-risk. I argue that flooding likely remains a challenge in subsidised housing areas, and make the case for examining flood-risk in poor formal areas.

Chapter 4 discusses the methods and approach to the research. It describes the thinking and reasoning behind the chosen methodology, and the process used to collect and capture the data. The chapter examines how the research sites were selected, explains the research tools and types of data collected, and discusses the limitations of the research and how these were addressed. It also documents how the data was analysed, including the choice of variables and analytical approach.

Chapter 5 describes the research area, research sites and households surveyed. This chapter aims to frame and contextualise the research findings discussed in Chapters 2 and 3, by locating the research area, sites and households socially, geographically and physically. As in many other cities in South Africa, Cape Town is divided into zones of relative advantage and disadvantage. While the city's wealthier residents live in and around the city centre and its northern and southern suburbs, its poorer population lives on the Cape Flats. This development pattern is rooted in Apartheid planning, which allowed non-whites only restricted access to urban areas, and forced people of colour into socially excluded and geographically Black and Coloured 'township' areas, such as the Flats.³ Chapter five explores this history and the political and socio-economic dynamics at play in the research area as a whole, as well as the specific histories and characteristics of each site. It also describes the physical and socio-economic features of the dwellings and households included in the study. I explore the physical and socio-economic marginality of the research sites and the households

³ Under apartheid classifications, the term 'Coloured' described individuals of mixed parentage, most often European and Malay or indigenous Koi San. Africans were generally classified as 'Black', although some designations categorised all those not from White European descent – Africans, Coloureds and Indians – as 'Black'.

in them. I also discuss the range of housing models included in the formal sample, and the potential differences in quality and process to which these allude.

Chapter 6 presents a descriptive analysis of the data. The chapter is the first of two chapters describing the research findings. Drawing on the survey and qualitative data collected, it examines the extent, nature and impact of flooding in the informal and formal settlements included in the study. The analysis in this chapter feeds into that in Chapter 7, which examines specifically and in greater detail the drivers of risk in formal, subsidised housing areas. The chapter seeks to answer the question of whether households moving into formal housing continue to experience flooding, how flooding impacts on affected households, and if and how their experiences differ from those living in informal dwellings. It also explores whether there are differences in the experiences of people living in formal housing built according to different housing models. I argue that instead of addressing flood-risk, the poor quality of subsidised housing serves to transform and transfer risk to housing beneficiaries. I also show that flooding takes new forms in subsidised housing areas. I argue that understanding flooding in subsidised housing areas requires a broader conceptualisation of flooding as a hazard.

Chapter 7 presents the findings of the statistical and spatial analysis of the data. It is the second of the chapters that describe the findings of the research. This chapter examines the drivers of risk in the five formal, subsidised housing sites. Drawing on the survey data, it uses binary logistic regression analysis to explore the role of architectural, physical and socio-economic factors in determining flood-risk, and the relative importance of different factors. The chapter also presents the findings of the spatial analysis, which examines the influence of topographical factors. Both the statistical and spatial analyses are complemented by the findings of the qualitative research, particularly with respect to respondents' perceptions of the drivers of risk. I argue that flood-risk in subsidised housing areas has a strong built environment component. Although discussions on flooding frequently focus on the political and socio-economic drivers of risk, I argue that the quality of dwellings is central to understanding flood-risk in subsidised housing areas, and that buildings need to be factored in to discussions on risk in Cape Town. I argue that although both flood-risk and quality concerns are structured broadly by the historical and current inequities

that shape settlements on the Cape Flats, differences between and within settlements suggest that these macro-factors alone are inadequate in explaining risk. I also argue that risk needs to be examined and understood at a household and settlement level. I suggest that differences are embedded in the history of each settlement and individual buildings, and can only be understood by examining the processes that make some more vulnerable than others.

Chapter 8 draws together the findings of the research. It positions the findings against the literature, and examines how well the empirical experiences of households living in subsidised housing conform to the assumptions made in prevailing approaches to flood-risk, and risk more broadly. It reflects on how risk, hazard and vulnerability are conceptualised and applied, and interrogates critically whether the prevailing framing of risk adequately captures the contemporary urban risk environment in Cape Town, and the implications for theory and practice. I argue that prevailing approaches to understanding risk fail to capture the experiences of households living in subsidised housing. I argue that neither the construction of the hazard, nor common positions on the drivers of vulnerability reflect the experiences of people living in formal housing on the Cape Flats. Capturing these experiences requires revisiting assumptions about who is vulnerable, to what they are vulnerable, the drivers of risk and at what scale it manifests.

Chapter 9 concludes the thesis. It recaps the goals of the research, draws together the key conclusions emerging from the study, and draws out the central theoretical arguments. It also identifies continuing gaps and areas for future research, and makes recommendations for theory and practice. I argue that by focusing on rainfall and inundation, and pre-determined categories of what flooding involves and who is vulnerable, we fail to capture fully how flood-risk manifests in the local context. We also discount its impact on households living in subsidised housing. I argue for a more expansive concept of flooding that encompasses flooding due to poorly built dwellings. I also argue for greater precision in how we understand and respond to risk, and for a more process-oriented approach that focuses on the dynamics driving risk in particular places at particular times.

CHAPTER 2

Weather and Society: The Construction of Risk in the Literature

Introduction

To paraphrase Kenneth Hewitt, the literature on flood-risk frames the hazard 'flooding' in terms of "water in the wrong place, or at the wrong time" (Hewitt, 1997:80). Flooding is typically considered a hydrometeorological hazard, triggered by meteorological conditions such as heavy rain, storms or changes in weather. Research and practice often focuses on its hydrological aspects, with flooding conceptualised in terms of too much water, or the flow of water into areas that are usually dry (for instance, Guha et al, 2012; Jha et al, 2011; Smith and Petley, 2009; ADPC, 2005a; 2005b; Hewitt, 1997; Alexander, 1993; 2000). Many discussions on flooding fail to define the hazard explicitly, and simply assume a common, implicit understanding of what constitutes 'flooding', but those that do often focus on various kinds of watercourse flooding, storm surges and coastal flooding (for instance, Jha et al, 2012; Smith and Petley, 2009; Alexander, 1993; 2000). An emerging body of literature on flooding in urban areas in the developing world extends the conceptualisation of endangering flooding from an issue of weather and hydrology to a more intimately developmental one, less rooted in natural systems (for instance, Fatti and Patel, 2012; Jha et al, 2012; Sakijege et al, 2012; Drivdal, 2011 a-b; Benjamin, 2008; Bouchard et al, 2007; Action Aid, 2006; Dixon and Ramutsindela, 2006). Nonetheless, the construction of the hazard remains in the same conceptual realm as the broader literature, with the emphasis on surplus water and the inundation of areas that are usually dry.

Discussions on flood-risk, and risk more broadly, also often construct vulnerability in particular ways. While the theory emphasises process, context and the accumulation of risk at a range of scales, the literature often assumes not only that flooding is about weather and hydrology, but also that the poor are most vulnerable, particularly

‘vulnerable groups’ such as women, the elderly, or those living in slums or informal settlements. Most also focus on the social drivers of vulnerability and risk, and emphasise socio-economic, macro-political and governance issues. Moreover, while most theoretical examinations of risk recognise that risk and vulnerability accumulate and manifest at the individual and household level, much of the literature conceptualises flooding at a collective scale. It is assumed, often implicitly, that flooding impacts on communities rather than individuals or single households.

This chapter examines how risk is conceptualised in the literature on disaster risk generally, and flooding specifically. It frames the analysis in the thesis by exploring how the hazard is presented in research and practice, the suggested sources of vulnerability and how risk manifests. I identify the suggested pathways linking hazard events and their impact, and the range of assumptions that underpin them. These include assumptions about which people are vulnerable, the sources of vulnerability and the level at which risk accumulates and impacts. The chapter begins by examining broadly how risk, hazard and vulnerability are defined. It then explores the construction of risk, and flood-risk in particular. It examines the drivers and affects suggested in the literature on flooding, in terms of how the hazard is conceptualised, the drivers of risk and the nature of realised risk. The chapter next discusses the assumptions underlying this construction of risk. It explores particularly how approaches to flooding, urban flooding and risk generally, construct and locate vulnerability, in terms of what and who is vulnerable; the drivers of vulnerability; and the scale at which both risk and vulnerability are discussed and applied.

The interaction of hazard and vulnerability: Defining risk

The concept of disaster risk emerged in the 1990s (Benjamin, 2008). Earlier conceptualisations saw isolated geophysical hazards such as earthquakes and storms as the cause of disasters, but from the 1970s onwards researchers and practitioners increasingly argued that human beings, and aspects of society, play a fundamental role in generating disaster risk. The former approach conceptualises risk in terms of exposure – broadly, the likelihood of a particular hazard occurring in an area - and the

frequency, duration and magnitude of an event. The latter views risk as the product of both the physical event and pre-existing vulnerability to its effects, and recognises that some are more affected by hazards than others. From this political ecology perspective, 'natural' disasters are in fact socially produced; it is not natural (or technological) hazards that cause disasters, but the way societies are structured which makes some individuals or groups vulnerable to their effects. As Terry Canon observes:

There is now much greater acceptance of the idea that disasters occur only when a vulnerable population "gets in the way" of a hazard. Disasters may be triggered by natural hazards, but can be considered largely a product of processes involving economic, political and social factors (2008:350).

Proponents of this approach argue that risk comprises two components: a hazard aspect and a vulnerability element. This relationship between risk, hazard and vulnerability is often expressed in terms of pseudo equations. The most widely used is that originally adopted by Blaikie and colleagues (1994), which states that Risk = Hazard x Vulnerability. However, there are multiple permutations of this basic formula. These reflect debates about whether vulnerability adds to or multiplies the effects of hazards, and whether issues such as exposure and resilience are components of vulnerability or are separate issues (for instance, Carreno et al, 2006; Thywissen, 2006; Alexander, 2002, cited in Kelman, 2002; Smith 2001).

There has been considerable debate on the concept of resilience, in particular, and its relationship to vulnerability.⁴ While acknowledging these debates, I do not explore the intricacies of risk resilience. This section does not examine the relationship

⁴ While most proponents of the political ecology paradigm accept that the capacity to withstand and recover from hazards is important in understanding their impact (for example, Manyena, 2006; Mustafa, 2005; Cardona, 2004; Davis, 2004; Wisner et al, 2004; Bohl, 2001; Smith, 2001; Blaikie et al, 1994), there is debate about how resilience relates to vulnerability. Some see resilience and vulnerability as opposite sides of the same coin while, others see them as distinct but related concepts (Manyena, 2006). Larry Mallak, for instance, argues that much as with job satisfaction and dissatisfaction, being one does not necessarily mean one is the other. Just as the absence of job dissatisfaction does not mean that you have job satisfaction, he notes "here, too, with resilience: the absence of vulnerability does not make one resilient" (cited in Manyena, 2006:443).

between hazards and vulnerability, or the precise components of vulnerability. It also does not examine vulnerability in any depth, or whether risk should include some measure of resilience, coping or response. Rather, it examines broadly how ‘risk’ and its core components of ‘hazard’ and ‘vulnerability’ are defined and, in the section thereafter, how risk and vulnerability, in particular, are applied in the literature. This is primarily an issue of focus. The thesis does not concentrate on the nature and components of vulnerability (or resilience) per se, but on how well prevailing constructions of ‘vulnerability’ capture the experiences of people living on the Cape Flats, and what this suggests about the way we understand contemporary risk in developing countries.

A dualistic concept: Conceptualising risk

Risk was historically, and sometimes still is, used synonymously with the word ‘hazard’. For example, in their review of how different disciplines see vulnerability, Jeffrey Alwang and his colleagues deconstruct vulnerability into components on a ‘risk chain’, where risks equate with shocks and are “characterised by their magnitude (including size and spread), their frequency and duration, and their history” (2001:2). The term is also sometimes used interchangeably with ‘vulnerability’ but most commentators distinguish between the two. Risk is generally defined as the potential for harm or losses due the interaction between hazards and people’s vulnerability to their effects, and is the product of probability and loss (Smith, 2001). The United Nations International Strategy for Disaster Reduction (UNISDR), for instance, defines risk as “the combination of the probability of an event and its negative consequences” (UNISDR, 2009b:25).

A recent report by the Intergovernmental Panel on Climate Change (IPCC) defines risk in much the same way. It argues that risk derives from “the interaction of social and environmental processes, from the combination of physical hazards and the vulnerabilities of exposed elements”. The authors argue that disasters thus represent the materialisation of risk, and are “a ‘becoming real’ of this latent condition” (Field et al, 2012:69). Omar Cardona (2004) adopts a similar perspective. He sees vulnerability as an internal risk factor reflecting the likelihood of a subject or system

being affected by a hazard, while risk is a composite idea comprising eventuality, consequence and context. He argues that although definitions of risk vary widely according to the particular conceptual and disciplinary context, risk always comprises a distinction between reality and possibility. Citing Luhmann (1990) he defines risk as “the possibility that an undesirable state of reality (adverse effects) will occur as a result of natural events or human activities” (2011:110).

Risk tends to be defined and conceptualised with respect to major disasters, but commentators increasingly distinguish between acute and chronic risk. In this view, the concept applies not only to the potential for harm triggered by headline-grabbing, infrequent events such as tsunamis, earthquakes or floods, but also to chronic, ongoing problems of underdevelopment (Oelofse, 2002). Proponents argue that it is these “risks of daily life” (Wisner 1993, cited in Pelling and Wisner 2009:38) that pose the greatest threat to poor urban communities in many parts of the developing world, particularly in urban areas (for example, Dodman et al, 2009; Wisner and Pelling, 2009b; Pelling and Satterthwaite, 2007; Morrissey and Taylor, 2006; Bull-Kamanga et al, 2003; Pelling, 2003). It is also with these risks that poor people themselves are primarily concerned (Wisner and Pelling, 2009).

Many now distinguish between intensive and extensive risk (for example, Browne, 2013; Mitchell et al, 2013; UNISDR, 2013; 2011; 2009a; Field et al, 2011; Dodman et al, 2009). In this view, intensive risk arises from localised but acute and potentially destructive events such as cyclones, earthquakes or tsunamis, while extensive risks comprise the potential for harm resulting from smaller-scale but more diffuse hazards. Extensive risks are driven by poverty, including issues of underdevelopment such as poor sanitation, disease and overcrowding, and play out at the individual and household scale. Global publications such as the 2009 (UNISDR, 2009a) and 2011 (UNISDR, 2011) Global Assessment Reports on Disaster Risk Reduction (GAR), published by the UNISDR, for example, have incorporated the concepts of intensive and extensive disasters, although they focus more on small, localised events than everyday incidents. The 2011 GAR, for example, argues that although intensive risk often receives the most attention:

In general, both the urban and rural poor face very high levels of everyday risk, associated with traffic and occupational accidents, malaria and health hazards associated with a lack of clean water, sanitation or pollution, crime, unemployment and underemployment, and other factors...A range of underlying risk drivers, such as poor urban governance, vulnerable rural livelihoods and declining ecosystems, contribute to the translation of poverty and every day risk into disaster risk, in a context of broader economic and political processes (2011:8-9).

Trigger events: Defining hazard

Hazards are generally defined as potentially damaging physical events. As Katharina Thywissen argues "...they all have in common the potential to cause the severe adverse effects that lie at the bottom of every emergency, disaster or catastrophe" (2006:485). The UNISDR, for instance, defines hazards as "a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage" (2009b:17). Hazards can take the form of:

- natural phenomena, such as heavy rain, strong winds or earthquakes;
- human-induced events such as toxic chemical spills, the use of nuclear weapons, or social violence; and
- socio-natural incidents resulting from a combination of natural processes and human intervention in nature, such as forest fires, landslides and floods (Schneiderbauer and Ehrlick, 2006).

Hewitt argues that, in the strictest sense, the term has an interactive and evaluative meaning, in that it depends on both the source of danger and the nature and concerns of human communities potentially exposed. However, he argues that in the language of most studies, "the hazard" is fire or strong winds, toxic chemicals or nuclear weapons" (1997:55).

Flooding is generally seen as a hydrometeorological threat. The UNISDR defines a hydrometeorological hazard as a “process or phenomenon of an atmospheric, hydrological or oceanographic nature” that may cause deaths, injury or health impacts, damage to property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009b:18). Examples include tropical cyclones, thunderstorms, hailstorms, tornadoes, blizzards, heavy snowfall, avalanches, coastal storm surges, floods including flash floods, drought, heatwaves and cold spells.

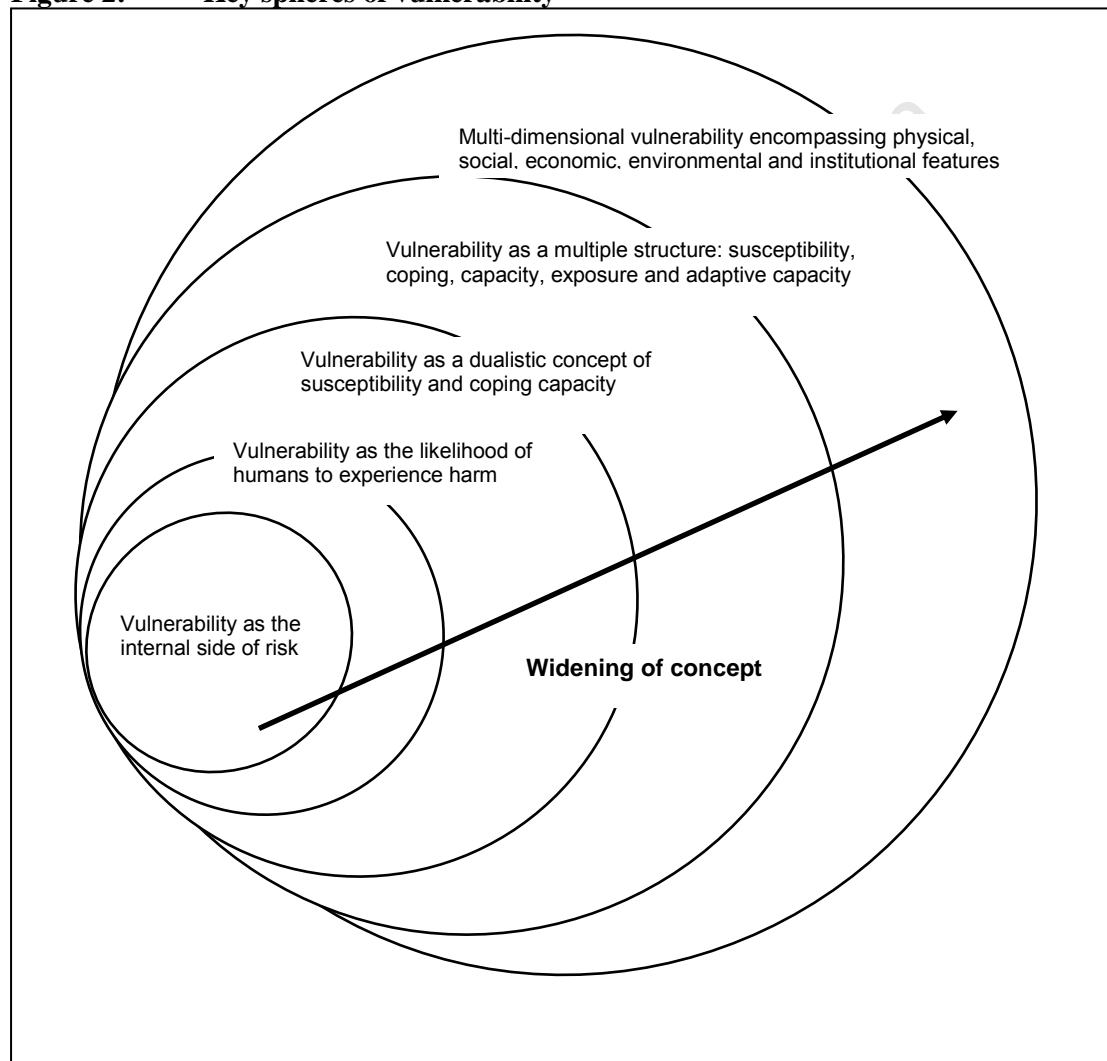
The internal component of risk: Perspectives on the nature of vulnerability

There is less agreement about the components of vulnerability. Although the concept has become a mainstay of the disaster literature, there is continuing debate about precisely what it involves (Burg, 2008; Cannon, 2008; Manyena, 2006; Schoon, 2005; Cardona, 2004; Cannon, 2003; Davis, 2003). As Thywissen (2006) argues, terms like vulnerability are envelopes for complex and interconnected parameters and processes. In a review on measuring vulnerability, for instance, Jorn Birkmann (2006) identifies at least 25 different definitions, concepts and methods used to describe vulnerability. He argues that this lack of consensus often makes it a difficult concept to pin down.

Birkmann (2006a) attempts to systematise the disparate concepts. He describes five spheres in the conceptualisation of vulnerability in the disaster-related literature (Figure 2). At the core of most concepts is the idea of vulnerability as the ‘internal’ side of risk, or an intrinsic characteristic that makes an element or system unusually susceptible to the negative effects of hazards (the inner circle). In this view, elements exposed to hazards are made vulnerable by biological, social and physical conditions, which are often considered ‘vulnerability characteristics’. In this narrowest form, the concept can be applied to communities and social groups, structures, buildings and lifelines, as well as to ecosystems and environmental functions. A wider conceptualisation (the second circle) still sees vulnerability as a characteristic, but applies the term exclusively to humans, referring to the likelihood of death, injury, loss and disruptions to livelihoods. The third sphere views vulnerability as a two-

sided concept, shaped by the likelihood of injury or loss (susceptibility) and people's ability to cope with and recover from hazard events. A more expansive concept, developed by the global environmental change community, moves beyond this dualistic notion, to include not only exposure and coping capacity, but also elements like sensitivity, adaptation and resilience (the fourth circle).⁵ The widest conceptualisation sees vulnerability as a multi-dimensional concept encompassing a range of physical, socio-economic, environmental and institutional dimensions.

Figure 2: Key spheres of vulnerability



Source: Birkmann, 2006a

⁵ The IPCC defines vulnerability as the propensity of people or systems to be harmed by stressors. This is determined by an element's sensitivity to the exposure (the degree to which a system will respond to a given change in climate, including beneficial and harmful effects); as well as their capacity to resist, cope with, exploit, recover from and adapt to the effects (the degree to which adjustments in practices, processes, or structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate) (Schoon, 2005).

Birkmann argues that theory and practice increasingly take a multi-dimensional perspective. He believes that debates on vulnerability now tend to focus on the need to address the physical, economic, social, environmental and institutional characteristics that drive vulnerability, including global drivers such as globalisation and climate change. In this respect, he notes, "...the focus has shifted from a primarily physical structure analysis to a broad interdisciplinary analysis of the multi-dimensional concept of vulnerability" (Birkmann, 2006a:18). For example, as discussed in Chapter 1, in Blaikie and colleagues' influential PAR model, vulnerability is generated through underlying causes, dynamic pressures and unsafe conditions. Underlying causes refer to macro-level factors, such as poverty and macro-economic systems. Dynamic pressures refer to processes such as poor service delivery, which serve to translate these root causes into unsafe conditions. These conditions are expressed in time and space, such as living in poor-quality housing or in a dangerous location, which leaves people more likely to be affected negatively by hazards (Wisner et al, 2004; Blaikie et al, 1994).

Despite the disagreement about its components, the literature on risk points to several broad conclusions about the nature of vulnerability. Vulnerability can be seen as situation-specific, interacting with particular hazards to generate risk. Vulnerability to financial crisis, for example, does not infer vulnerability to climate change or natural hazards (Field et al, 2012). People's vulnerability is determined by hazard-independent, structural constraints arising from social, cultural, economic and political dynamics (Gaillard, 2010). Vulnerability to hazards also reflects people's marginalisation within society. As Gaillard observes:

Disasters thus hit individuals with limited and fragile incomes (low wages, informal jobs, lack of savings) that reduce the capability to deal with natural hazards (location of home, type of housing, knowledge of protection measures), thereby inhibiting development processes. Vulnerability and marginality also result from inadequate social protection (health insurance, health services, construction

rules, prevention measures, etc.) and limited solidarity networks (2010:222).

Vulnerability varies across physical space and among and within social groups; is scale-dependent, differing in nature at the individual, household, regional or system levels; and dynamic, changing over time (Gaillard, 2010; Vogel and O'Brien, 2004, cited in Birkmann, 2006a).

The potential for harm: Summarising the conceptualisation of risk

The components of risk are debated within the disaster risk reduction and management literature, but discussions on its nature suggest certain themes. 'Risk' is seen as the potential for negative outcomes given the interaction between hazards and vulnerability. Proponents of the political ecology approach recognise that risk – and where risk manifests, disasters – is rooted in unresolved developmental challenges. However, commentators increasingly argue that risk is often diffuse and mundane, manifesting as numerous, localised problems, often at the individual and household scale. While risk encompasses acute and potentially destructive events such as tsunamis and earthquakes, it also often refers to accidents, dwelling fires and other 'everyday' challenges driven by issues such as poor sanitation, disease and overcrowding.

Hazards are seen as physical phenomena or activities with the potential to cause harm. Hazards can take the form of natural phenomena, human-induced events such as toxic chemical spills, the use of nuclear weapons, or social violence. They can also be comprised of socio-natural events stemming from the interaction between human and natural systems, such as forest fires, landslides and floods. As with 'risk', hazards refer to potential problems. As Thywissen argues, "a hazard is a threat, not an actual event...if it can be measured in real damage or harm, it is no longer a hazard but has become an event, disaster or catastrophe" (2006:486). Flooding is classified as a hydrometeorological hazard, triggered by atmospheric conditions such as storms, hydrological processes or oceanographic phenomena such as storm surges.

The components of vulnerability are contested but, like risk, vulnerability is a forward-looking concept and indicates the potential for damage or harm (Thywissen, 2006). Setting aside debates about its precise components, vulnerability is broadly conceptualised as a “defencelessness” (Chambers, 1989:1) that makes some more likely to be harmed by hazards than others. While the literature points to drivers, such as poverty and marginalisation, that increase vulnerability to a range of hazards, there is broad agreement that the drivers are complex and multi-faceted. People are made vulnerable by inequities in society, but vulnerability is also dynamic and varies over time and space. Vulnerability also differs between individuals and households, and according to the hazard. It is hazard and context-dependent; it needs to be understood with reference to particular hazards, in particular settings.

Against the backdrop of these broad definitions, the next section examines how flood-risk is viewed in the international literature on flooding and urban flooding, in particular. The section focuses specifically on how flooding is constructed and conceptualised as a hazard, the drivers of risk, how these drivers interact to produce negative outcomes, and how and by whom the effects are felt.

Surplus water and unsustainable development: The conceptualisation of the hazard, risk accumulation pathways and impact in the literature

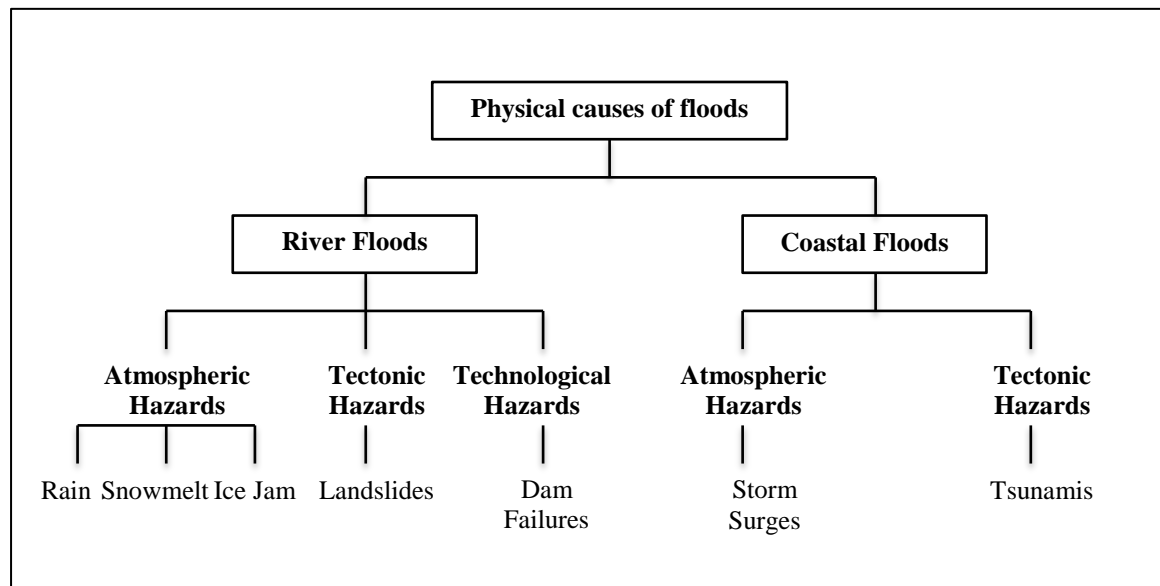
Despite the increasing emphasis on the social roots of vulnerability, flooding is still often conceptualised in hazard-focused terms. An emerging body of literature on urban flooding identifies additional types, rooted in developmental issues and the nature of the built environment, but the hazard remains primarily conceptualised from a hydrometeorological perspective. ‘Flooding’ is envisaged in terms of too much water, triggered for the most part by atmospheric phenomena such as heavy rainfall, melting snow and ice, or storms.

River and coastal floods: Conventional conceptualisations of flooding

Prevailing approaches to understanding endangering flooding tend to emphasise hydrological factors. David Alexander (1993; 2000), for instance, defines flooding as the height or stage of water above a given point, such as a riverbank or channel. The Asian Disaster Preparedness Centre (ADPC) conceptualises flooding in much the same way, arguing that flooding occurs “when river levels exceed their natural banks and water overflows” (ADPC, 2005a:12). Debby Guha and colleagues from the Centre for Research on the Epidemiology of Disasters (CRED) expand this conceptualisation slightly. They define flooding as a significant rise of water level in a stream, lake, reservoir or coastal region (Guha et al, 2012). As noted already, Hewitt discusses flooding in more general terms but maintains an emphasis on hydrological excess. He defines flooding as an inundation of occupied land. In a similar vein, Abhas Jha and his colleagues (2011) describe flooding as a flow of water over areas that are usually dry.

In keeping with the focus on the hydrological aspects of flooding, discussions tend to focus on kinds of watercourse flooding, storm surges and coastal flooding. As noted in Chapter 1, Alexander (1993), for instance, identifies river floods due to heavy rain or melting snow, estuarine floods, coastal floods due to hurricanes, severe storms or tsunamis and catastrophic events. In their paper, Jha and colleagues (2011) adopt a similar approach, but add flash floods due to rain, glacial or snowmelt and flooding due to ground infiltration. Smith and Petley (2009) take much the same position, but organise their concepts around river-based flooding and coastal flooding (Figure 3).

Figure 3: The physical causes of flooding



Source: Smith and Petley, 2009

This conceptualisation of flood-risk has been strongly influenced by assumptions about floods within the natural, rural environment, with little attention given to flooding in urban contexts (Zevenbergen, 2007). This reflects a broader rural bias in the theoretical and practical underpinnings of disaster science. This bias is particularly evident in Africa where, Mark Pelling and Ben Wisner argue, one would think that countries “suffer mostly from drought, food emergencies (both often exacerbated by violent conflict), epidemics and floods” and where “the overwhelming impression is of rural vulnerability to the vicissitudes of climate, pests, warlords and tyrants” (2009:25). They see this bias as out of step with development in Africa, which is now urbanising faster than any other region of the world.

Hard surfaces, disrupted systems and infrastructure failures: Flooding in urban areas

Research on flooding in urban areas is beginning to address this bias. This emerging literature, much of it from Africa, shows that urbanisation often serves to amplify the effects of hazards such as heavy rainfall (see for example, Jha et al, 2012; Pelling and Wisner, 2008; United Nations Development Programme, 2004; Pelling, 2003; Parker, 1999; Hewitt 1997; Alexander 1993; 2000). For example, the proliferation of impermeable surfaces increases run-off and results in rainwater and melting snow accumulating or ponding in paved-over and low-lying areas. Similarly, damage to natural drainage systems and aging and inadequate drainage infrastructure increase the risk of rivers and drains over-topping (for example, Fatti and Patel, 2012; Ziervogel and Smit, 2009; Pelling and Satterthwaite, 2007; Hewitt, 1997). As noted in a 2006 report on urban flooding in Africa by Action Aid International:

Flooding in urban areas is not just related to heavy rainfall and extreme climatic events; it is also related to changes in the built-up areas themselves. Urbanisation aggravates flooding by restricting where floods waters can go, by covering large parts of the ground

with roofs, roads and pavements, by obstructing sections of natural channels, and by building drains that ensure that water moves to rivers more rapidly than it did under natural conditions. As people crowd into African cities, these human impacts on urban land surfaces and drainage intensify (2006:3).

This research adds new types to the conventional flooding typologies, although these remain largely within the same conceptual realm. The 2009 GAR, for example, attributes much flooding in urban areas to the disappearance of wetlands that traditionally absorbed and moderated peak flooding and to the encroachment of housing onto floodplains. In addition to flooded rivers, coastal floods, pluvial and ground water floods, Jha and his colleagues (2012) note that flooding in urban areas often results from artificial system failures, such as where waters breach a dam or an embankment fails to protect developments. It is also frequently to inadequate drainage and storm water management. Research in Dar es Salaam, Tanzania, identifies flooding caused by the dumping of solid waste and rubble into watercourses (Sakijege et al, 2012), while the report by Action Aid (2006) identifies four different types of urban flooding in African cities. These include:

- localised flooding due to inadequate or poorly functioning drainage infrastructure;
- flooding from small streams whose catchment areas lie almost entirely within built-up areas;
- flooding from major rivers on whose banks the towns and cities are built; and
- coastal flooding from the sea, or by a combination of high tides and high river flows from inland.

Research in South Africa adds additional perspectives. Although most research and practice focuses on the hydrological aspects of flooding (Benjamin, 2008), as internationally, an emerging literature is extending how flooding is understood. Research in South Africa's Western Cape province highlights three more types of flooding locally. These include flooding resulting from the expansion of settlements into wetlands and other waterbodies that appear dry but flood during the wetter months; flooding in low-lying areas with a high water table; and that linked to water

leaking through poorly constructed roofs, walls and doors (Drivdal, 2011 a-b; DiMP, 2008; DiMP, 2007; Bouchard et al, 2007).

Drawing on aspects of this research and the Action Aid report discussed in the previous section, Benjamin (2008) identifies eight types of flooding pertinent to urban areas in South Africa.⁶ These include:

- Ponding and surface run-off in areas where drainage is poor or drainage infrastructure is lacking or inadequate (see, for example, Figure 4a and b)
- Flooding from small streams within urban areas
- Flooding from major rivers that pass through urban areas
- Coastal flooding
- Flooding from wetlands where settlements extend into wetland ecosystems (see Figure 4c);
- Flooding resulting from overflowing storm water channels and other drainage infrastructure (see Figure 4d);
- Seepage, or 'rising flooding', where groundwater upwells through dwelling floors due to a high water table (Figure 4e); and
- Flooding due to leaking shacks or cracked masonry (Figure 4f)

Most flooding in Cape Town, and on the Cape Flats in particular, falls within this spectrum of flood-types. Although parts of Cape Town experience river flooding, storm surges, flash floods and sometimes mudslides (Arton-Powell, 2006), these are not the primary concerns on the Cape Flats. Most flooding on the Flats takes the form of water percolating to the surface, road run-off, the persistent accumulation or ponding of water in low-lying areas, and the expansion of settlements into wetlands and detention ponds which flood naturally during the rainy season (Drivdal, 2011 a-b;

⁶ As discussed in Chapter 2, the report by Action Aid International (2006) identifies four different types of urban flooding in African cities. These include: localised flooding due to inadequate or poorly functioning drainage infrastructure; flooding from small streams whose catchment areas lie almost entirely within built-up areas; flooding from major rivers on whose banks towns and cities are built; and coastal flooding from the sea, or by a combination of high tides and high river flows from inland. The report notes that floods of the first and second types are much more frequent than those from major rivers and, while smaller in scale, serve to spread disease, interrupt schooling and destroy houses, assets and income.

Armitage et al, 2010; Bouchard et al, 2007; Dixon and Ramutsindela, 2006).⁷ The City of Cape Town's Disaster Risk Management Centre (DRMC), for instance, identifies four primary risk factors for flooding in informal settlements:

- Dwellings in trapped low-lying areas without drainage
- Dwellings within 1:20 year floodplains and within 25 metres of watercourses
- Dwellings in wetlands (typically seasonal wetlands which are dry in summer)
- Dwellings in storm water detention ponds, which are dry during the summer but are specifically designed to capture and retain water during the wet season (City of Cape Town, 2009, cited in Ziervogel and Smit, 2009).

Figure 4: Different types of flooding in South Africa



Figure 4a) An illustration of ponding (Sweet Home, November, 2010)



Figure 4b) An illustration of run-off (Thembaletu, August, 2006)



Figure 4c) An illustration of encroachment into wetlands (Kanana, November, 2010)



Figure 4d) An illustration of overflowing drainage infrastructure (Sweet Home, November, 2010)

⁷ Detention ponds are flood control mechanisms. A detention pond is a low-lying area that is designed to temporarily hold excess water while slowly draining water away from areas prone to flooding. Ponds often comprise a grassy field with concrete culverts running towards draining towards infrastructure. In Cape Town, they are dry in the summer and fill with water during the winter rainy season.



Figure 4e) An illustration of seepage or upwelling due to a high water table ('rising flooding') (Khayelitsha, June, 2006)



Figure 4f) An illustration of leaking walls (Thembaletu, August 2006)

People in the way: The sources of vulnerability

Discussions on flooding frequently stress the physical factors driving risk. In keeping with the emphasis on hydrology, risk assessment and monitoring often draws heavily on physical science approaches. These focus on measuring and predicting changes in water levels and other aspects of hydrology and hydraulics. Writing on South Africa, for instance, Ameen Benjamin (2008) argues that risk reduction research and practice is oriented towards measuring and addressing the hydrological components of risk (Benjamin, 2008). The majority of flood-related research focuses on modelling hydrological elements such as catchment capacities and characteristics and flow rates.

More socially focused research, particularly the work on urban flooding, focuses on the societal aspects of risk. In addition to the physical changes to the landscape wrought by urbanisation, this identifies a range of socio-economic and governance issues that serve to drive risk. These include population expansion, which encourages settlement in flood-prone locations close to waterbodies or on floodplains, and puts pressure on drainage infrastructure (Jha, 2012; Pelling, 2003). Many emphasise poverty and marginalisation, which forces people to live in hazardous places, frequently in low-quality, poorly weatherproofed dwellings that do little to protect their occupants when flooding occurs (Zevenbergen et al, 2008). The Action Aid report for, instance, observes:

Poor people and poor communities are frequently the primary victims of floods, partly because they cannot afford to live in safer areas and have crowded, makeshift houses. Flooding hits poor families particularly severely because injury, disability and loss of life directly affect their main asset, their labour (2006:3).

Unsustainable development plays a key role in driving risk, through inappropriate land use patterns and poorly managed urban growth (Jha et al, 2012; Ziervogel and Smit, 2009; Zevenbergen, 2007; Action Aid 2006; Alexander, 2000). Poor regulation often allows the proliferation of slums or informal settlements, while rapid increases in urban populations outpace service provision. As Pelling (2003) writes:

The demographic expansion of cities, increasingly fuelled by natural population growth, is a fundamental contributing factor to risk when it outstrips the capacity of the urban economy and the skills of urban managers to generate sufficient resources to offer ways of meeting the basic needs of a city's citizens...[it is] in the inner-city slums that economic poverty and political marginalisation are most likely to combine to produce households that are both exposed to environmental hazard and that hold insufficient resources to cope with any disruptions to livelihoods or ill-health that may result from such exposure (2003:45).

Weak institutional responses also contribute to risk. These include poorly conceived and implemented prevention activities that fail to address the root sources of risk (Mustafa, 2005) and poor or inappropriate risk management activities (Fatti and Patel, 2012; Jha et al, 2012; Ziervogel and Smit, 2009). Flood-prevention and response activities are also often hampered by insufficient coordination between the different public agencies involved, and limited political will to address problems (Diagne, 2007).

Too much water, unsustainable development: Assumptions in the literature on flooding

In summary, the literature on flood-risk conceptualises 'flooding' and its drivers in very particular ways. Flooding is generally considered a hydrometeorological hazard, triggered by atmospheric conditions such as heavy rainfall, storms or other changes in weather. Prevailing constructions of risk are primarily informed by flooding in the rural environment, and flooding is conceptualised largely in hydrological terms. Research in urban areas, particularly in developing countries, highlights additional and often unique types of flooding in urban areas, but most focuses on flooding due to storm surges, overflowing waterbodies and melting snow and ice.

Research on flooding in urban areas in developing countries is extending how flooding is understood. This shifts the conceptualisation of flooding from an issue of weather and hydrology to a more intimately developmental one that is less rooted in natural systems - although the hazard remains conceptualised in broadly the same way as in the more conventional approaches. This literature shows that flooding in urban areas is often linked to rapid and poorly managed urban expansion and to development challenges such as inadequate drainage infrastructure and the proliferation of informal settlements. Research in the Western Cape extends these typologies still further. This work identifies flooding due to urban sprawl into wetlands and annual waterbodies, a high water table and leaks in poor-quality and poorly constructed and weatherproofed dwellings.

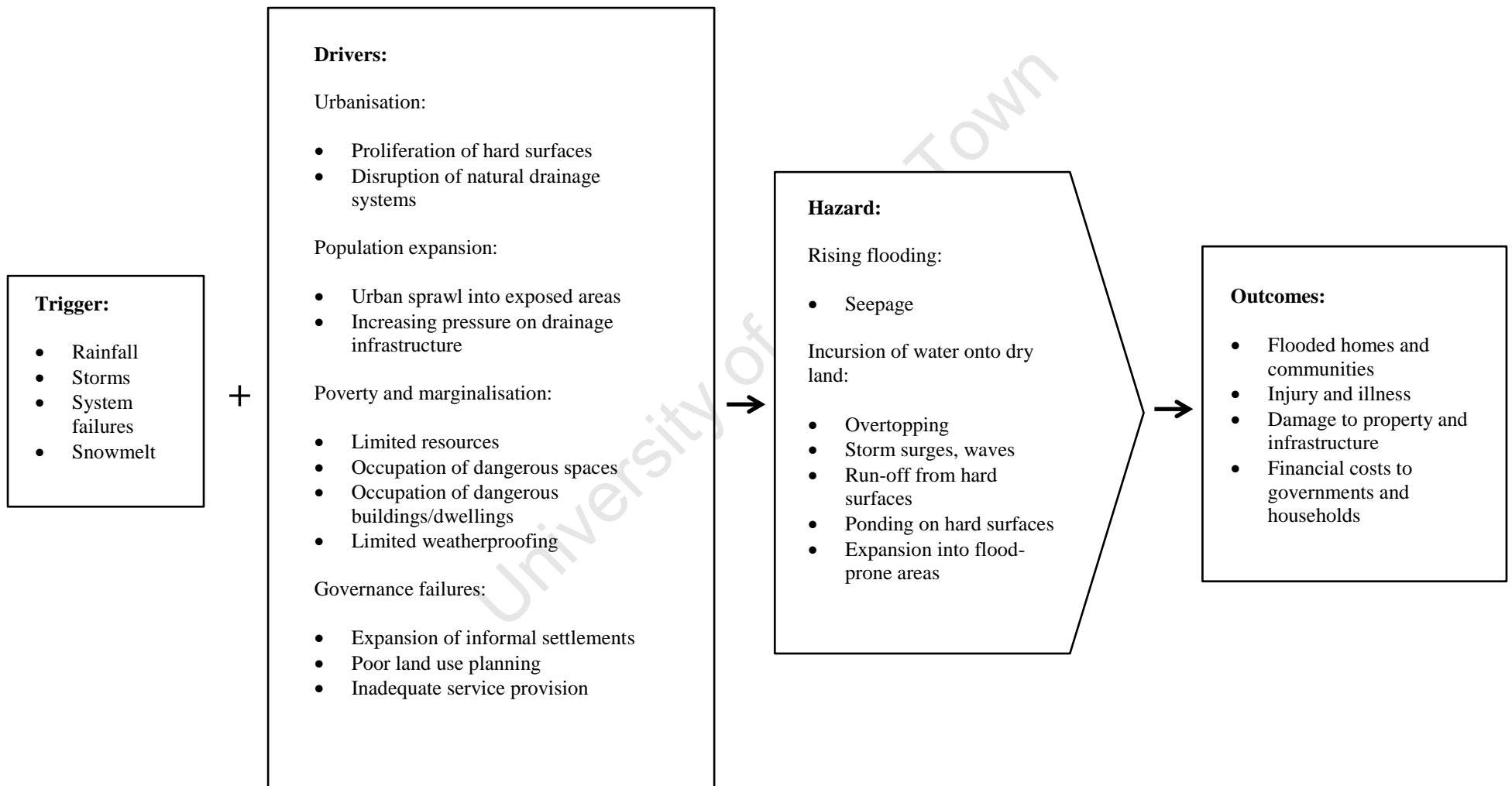
The literature on flooding and urban flooding implies a particular construction of the hazard, causal pathways and effects. Figure 5 (see page 47) summarises the causes and effects suggested in both conventional approaches to flooding and the emerging research on urban flood-risk. It shows that, although the literature on urban flooding identifies more developmental drivers of risk, the hazard remains surplus water triggered primarily by atmospheric conditions. Rain, storms or changes in weather result in waterbodies overflowing, storm surges, run-off from hard surfaces, or other types of inundation. Land use dynamics, developmental issues, governance failures and features of the built environment serve, in the terminology of the PAR model, as dynamic pressures that create unsafe conditions such as settlement in dangerous

spaces and places exposed to flood-hazards. The outcome is human losses; flooded dwellings, communities or areas; and damage to both private and publically owned property and infrastructure (for instance, Faling et al, 2012; Jha et al, 2011; Pasteur, 2011). These impacts, in turn, feed an accumulation of vulnerability over time, creating a feedback loop with the dynamic pressures driving risk.

Underlying this construction of causality is a range of assumptions about which people are vulnerable, sources of vulnerability and the level at which risk accumulates and manifests. The research on urban flooding, for instance, suggests a strong link between poverty and risk. Much of this research argues that it is the poor who are most vulnerable, particularly those living in informal settlements, where dangerous locations, low-quality housing, inadequate or poorly maintained drainage infrastructure and limited service delivery leave them both particularly exposed to flooding, and amplify its impact. Commentators also frequently argue that risk is socially constructed. It is primarily socio-economic and governance issues that drive vulnerability. Flood-risk also tends to be conceptualised at a collective level (Alwang et al, 2001), the assumption being that whole communities and areas are affected by overflowing rivers, system failures or other hazards.

The next section examines some of these assumptions. Drawing on the broad conceptualisation of risk and flood-risk discussed in this and the previous section, it explores how risk and vulnerability are discussed and applied. It looks particularly at who is considered vulnerable, the drivers of vulnerability, the scale at which risk and vulnerability occur and how they manifest.

Figure 5: Causal pathways with respect to flooding in the literature



Socially produced, collective and coarse: The application of risk and vulnerability in the literature

While theoretical discussions on risk and vulnerability often highlight the complexity of these concepts, many make broad assumptions about who is at risk and what makes them vulnerable. As discussed earlier in this chapter, authors such as Wisner and colleagues (2004), Pelling (2003), Blaikie and colleagues (1994), Hewitt (1983; 1997) and several others, argue that these concepts are dynamic and context-specific, but they are often applied with less subtlety. While the literature is far from unified, the concepts of risk and vulnerability are often used coarsely, losing many of the nuances identified in conceptual discussions. This section explores three issues in particular: how discussions on risk frame and locate vulnerability, in terms of what and who is considered most vulnerable; how the drivers of vulnerability are conceptualised; and the scale at which both risk and vulnerability are discussed and applied.

The ‘vulnerables’: Constructions of what and who is vulnerable

The concept of vulnerability has been applied in a range of ways in the literature, but it is increasingly applied only to people. As noted earlier, in its narrowest form the concept of vulnerability can be applied to humans and structures, buildings and lifelines, ecosystems and environmental functions. The early literature, in particular, viewed humans as only one of several vulnerable elements with the potential to suffer losses (Field et al; 2012; Birkmann, 2006a; Davis, 2003; Wisner, 2001), casting, Wisner argues, “a net in a crude and undifferentiated way over things, systems and people” (2001:3). There are still those who apply vulnerability in this way (for example, Alexander, 2000), but most authors either distinguish social vulnerability - the susceptibility of humans and the conditions necessary for their survival - from biophysical vulnerability (Birkmann, 2006a; Manyena, 2006), or apply the term only to human conditions. For example, rather than being vulnerable, Blaikie and his colleagues (1994) and Wisner and colleagues (2004), consider buildings as

‘susceptible’ or ‘unsafe’, economies ‘fragile’, unstable slopes ‘hazardous’ and places ‘disaster-prone’.

Reflecting the growing consensus that some people are more affected by hazards than others, many leading definitions conceptualise vulnerability as the characteristics of particular people that increase the likelihood of them suffering harm. Wisner and colleagues, for instance, define vulnerability as the “characteristics of a person or group and their situation that influence their capacity to cope with, resist and recover from the impact of a natural hazard” (2004:11). The UNISDR defines vulnerability in a similar way, as the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard” (2009:30). Such characteristics include class (including differences in wealth), occupation, caste, ethnicity, gender, disability and health status, age, whether or not people are in a country legally or illegally and the nature and extent of their social networks (Wisner et al, 2004).

While much of the literature recognises that the impact of hazards on people varies according to the hazard, time and location, in practice, vulnerability is often equated with belonging to vulnerable groups. At least partly because social vulnerability is difficult to quantify (Cutter et al, 2003), vulnerability is conflated with ‘the vulnerables’ (Holloway, personal communication, August 2012). Wisner (2001), for instance, argues that discussions on social vulnerability have tended to translate into “laundry list” taxonomies of vulnerable groups, such as women, children, the elderly, or the disabled which, although useful for coalface implementers, are inadequate for properly understanding risk. He argues that while the taxonomic approach helps to:

...rescue human beings from the amorphous semantic caldron that mixed the mechanical response of buildings, bridges and natural gas lines with the ability of a single mother to re-establish a home and livelihood after a hurricane. However, analytically these taxonomies and lists are still rather blunt tools (2001:4).

Vulnerability is also often equated with poverty. Cannon argues that, although vulnerability is used analytically as a means to show how people become vulnerable

due to particular personal (or household, or community) characteristics, these characteristics are often “conflated with poverty and “marginalisation”, and often with pre-assumed stereotypical groups (typically the elderly, women, and children)” (2008:215). Moreover, while the term was incorporated into the political ecology literature to emphasise the causal (and inherently political) economic and social processes that generate risk, he argues that:

It is often also de-politicised, so that we see reports of a disaster in which “the vulnerable were hit badly”, in a post hoc accommodation with the banal and obvious. As with the term poverty, we find that the causes are not properly discussed, just in case that might require a radical shift in the way that assets and wealth are owned and controlled in the world. So although this use of the term may acknowledge that vulnerability is socially-constructed, the form of social construction involved is removed from the crucial power relations that are involved (2008:215).

Simon Levine and his colleagues (2012) take a comparable position. They argue that the concept of vulnerability provides a useful tool for looking at the dynamics that restrict people’s choices and opportunities, but by applying it crassly to “huge pre-defined ‘categories’ of people...the word has lost its links to threats and processes, and ceased to look forward to future risks” (2012:49).

Cannon (2008) also argues that equating vulnerability with poverty is problematic as the specific characteristics of risk, and factors that may be different from poverty, will be ignored or played down. He believes that vulnerability must be conceptualised in terms of people being vulnerable to something – natural hazards of various types – due to social characteristics that make them more or less likely to experience harm. Robert Chambers too, argues that failing to distinguish vulnerability from poverty contributes to unhelpful stereotypes “of the amorphous and undifferentiated mass of the poor” (1989:1). He notes that vulnerability is not about poverty per se, but rather defencelessness mediated by individuals’ store of assets. As Erika Coetzee notes:

Poverty and vulnerability are often closely related: the most poor are usually also amongst the most vulnerable. Yet poverty does not coincide in the same way in all cases. People experiencing vulnerability are not necessarily poor; and amongst the poor there may be varying levels and patterns of vulnerability – depending on the multitude of dynamic processes through which individuals and households respond to changes in the environment, adopt and adjust strategies and reconfigure their relative well-being (2002:5).

This issue links to broader debates around the temporal aspects of vulnerability. While discussions on risk often construct vulnerability as a characteristic, many commentators argue that vulnerability is not a steady state; people become more or less vulnerable over time depending on the particular dynamics at play. Dorothea Hilhorst and Greg Bankhoff (2004), for example, argue that vulnerability is not a property of social groups and individuals, but is embedded in complex social relations and processes, while Pelling (2003) argues that vulnerability is mediated by people's ability to cope at a given moment. In this vein, the United Nations Development Programme (UNDP) defines vulnerability as “a human condition or process resulting from physical, social, economic and environmental factors which determine the likelihood and scale of damage from the impact of a given hazard” (UNDP 2004:11). Jericho Burg summarises these positions succinctly. He observes, “people are not simply vulnerable: they are vulnerable *to* something...vulnerability describes not a general state, but a dynamic relationship” (2008:609).

Such situational approaches seek to move beyond “laundry lists” and taxonomies and acknowledge complexity, change and contingency (Wisner, 2001). Wisner argues that they “break out human beings in their complexity and also groups of humans from the heterogeneous mass of things and systems said by mainstream planners to be “vulnerable.”” (2001:5). They recognise that it is not what kind of group a person or family belongs to, but the nature of their daily life, their situation and changes to it that make people vulnerable. In contrast to the taxonomic approach, this perspective recognises that social vulnerability is not a permanent property of a person or group, but changes in respect to a particular hazard and over time. It also acknowledges that vulnerability is produced through overlapping identities and forms of empowerment

or marginality. Wisner and colleagues (2004) provide an example, comparing women living in close proximity in Los Angeles. While research found large numbers of young, low-income immigrant, non-English speaking, single, Guatemalan mothers living in an area prone to cargo explosions, liquefaction and more intense shaking during earthquakes, only miles away, women with an entirely different set of circumstances lived very different lives:

The concatenation of income, age, immigration status, language and single parenthood significantly shifts the meaning of 'gender' as a simple category or box-to-tick taxonomy of vulnerability. Only two miles away from San Pedro, other women live in mansions overlooking the Pacific Ocean from the heights of Rancho Palos Verde. They share the socially constructed identity of 'women' with these young Guatemalan single mothers, but in most other respects, they inhabit a separate universe (2004:16).

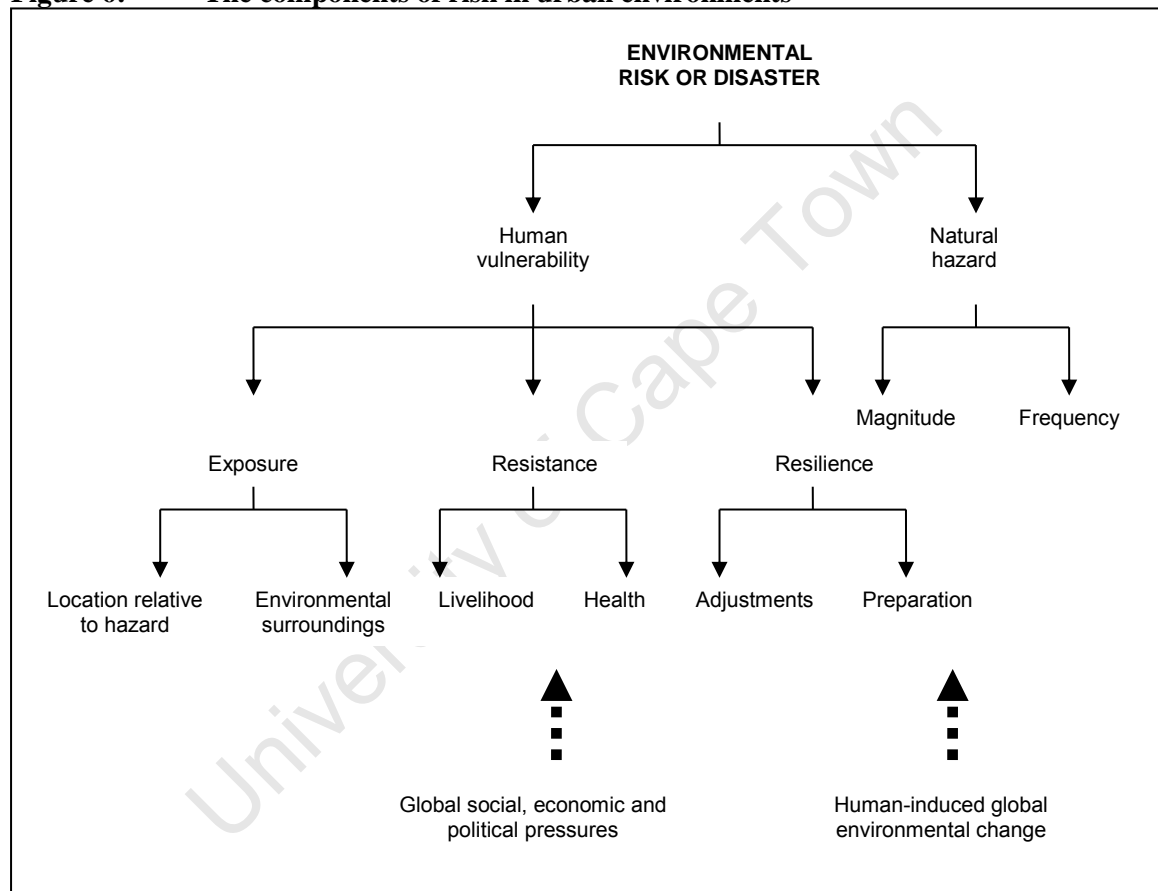
The social construction of risk: Discussions on the drivers of vulnerability

The literature also focuses on the social construction of vulnerability. Alongside the conceptual shift towards people as the locus of vulnerability, there has arguably been a move away from the physical drivers of vulnerability, such as features of the built environment, to a more society-centred approach. For instance, although the PAR model identifies poor-quality housing and dangerous locations as unsafe conditions that increase people's vulnerability to hazards, the causality is traced back to macro-economic and political processes. While the model acknowledges that unsafe, exposed housing increases vulnerability, the emphasis is on the underlying social conditions that result in poor-quality housing being built in high-risk areas.

Not all theorists focus on the social. In her hazards-of-place model, Susan Cutter (in Cutter et al, 2003) for instance, sees the quality of human settlements, including housing type and construction, infrastructure and lifelines, as important in determining vulnerability. Similarly, Pelling's (2003) concept of exposure derives from the physical location and character of the built environment. Drawing on the

ideas expressed in the PAR model, he emphasises the importance of understanding not only the socio-economic and political drivers of vulnerability, but also the physical aspects associated with buildings and the nature of the hazards to which people are exposed (Figure 6). Thus, he argues, “those people without access to safe housing (the homeless, those living in slums, squatter settlements or cramped rental accommodation) will be amongst the most exposed to, and least able to cope with, shocks from environmental hazards” (Pelling 2003:59).

Figure 6: The components of risk in urban environments



Source: Castree and Braun, in Pelling, 2003

Cardona and colleagues (Cardona 2004; developed in Carreno et al, 2007) also include a built environment component. They see physical exposure, or the susceptibility of human settlements to a dangerous phenomenon due to their location and lack of physical resistance, as one component of vulnerability. They position physical exposure alongside social fragility, which stems from social exclusion and marginality, and a lack of resilience, or an inability to cope with and recover from the

impact of hazards. They categorise these into ‘hard’ risk factors that are bound up with hazard and ‘soft’ risk factors, which are non-hazard dependent and related to social factors.⁸ Briguglio (2003) adopts a similar position, arguing that ‘hard’ interventions relating to buildings and other infrastructure help to determine levels of risk. Likewise, Dennis Mileti and Julie Gailus argue that disasters are:

...the predictable result of interactions among three major systems: the physical environment (the events themselves); the social and demographic characteristics of the communities that experience them; and the buildings, roads, bridges, and other components of the built environment (2005:494).

For the most part, however, these approaches continue to conceptualise the inadequacies of the built environment primarily as a product of socio-political and economic processes, rather than buildings as active drivers of vulnerability. In this view, features of society contribute to the proliferation of weak buildings that fail to protect occupants or to withstand hazards when they occur. For instance, Ilan Kelman (2002) defines vulnerability in a similar way to Pelling (2003), in terms of resistance, or the ability to withstand change due to a hazard; resilience, or the ability to return to the original state following a hazard event; and susceptibility. With respect to the impact of flooding on dwellings, he argues:

A house has resistance in its ability to prevent structural collapse due to external water pressure. A house also has resilience in its material’s physical properties relating to the ability to dry without damage following inundation. Finally, a house has susceptibility or exposure due to its value and location. The house’s physical vulnerability to a flood is influenced by other aspects of society, including social vulnerability such as the occupiers’ actions before the flood or the government’s long-term economic and development policies (2002:15).

⁸ In a revised version of the model, Martha-Liliana Carreno, working with Cardona and Alex Barbat (2007), redefines ‘hard’ and ‘soft’ risk in terms of ‘physical damage’, or the first order impact, and ‘impact factors’, or the second order impact respectively.

The literature on seismic risk has a stronger focus on the built environment, particularly housing, in driving vulnerability. The literature on earthquakes and earthquake protection recognises that the bulk of earthquake losses are due to the collapse of buildings (Smith and Petley, 2009). This literature identifies poor design and construction as central reasons why buildings are damaged or collapse. In this view, the impact of earthquakes is mediated by factors such as siting; the shape, design and plan of structures; building materials; their linkages to other buildings; and the age of the building and its levels of maintenance (Davis, personal communication, December 2012; Hosseini, 2007; Arambepola, 2007; Anbarci et al, 2005; Alexander, 2000). Commenting on the collapse of more than 60 000 buildings in the earthquake in Izmit, Turkey in 1999, Alexander notes, for instance, that “patterns of damage were closely related to the quality of construction and the degree of observance of anti-seismic building practices, which, given the high number of casualties, can be judged to be spectacularly low” (2000:19). The literature identifies the need for earthquake resistant design and construction methods and the establishment and enforcement of appropriate building codes and regulations.

This literature recognises that the quality of buildings and their construction is rooted in larger socio-economic and political dynamics, but places greater emphasis on features of the built environment in driving vulnerability than is generally the case with other aspects of disaster risk science. Roger Billam (2012), for instance, identifies three issues impacting on how and where people build. These include:

- corruption within the building industry, which undermines building codes and encourages corner cutting;
- ignorance about the importance of earthquake resistant buildings and poverty, which encourages the use of inappropriate materials and design; and
- the settlement of high-risk locations.

Practical Action (no date), an international non-governmental organisation (NGO) that uses technology to challenge poverty, takes a comparable position. They add that poverty makes people extend and improve their houses in stages, and results in a lack

of disaster consciousness, as people focus on daily survival rather than taking a longer-term view, both of which can reduce the levels of earthquake resistance built into dwellings. Lee Boshier and Andrew Dainty (2011) note that the fragmentation of the construction industry also reduces resistance. In particular, they argue that the limited interaction between those who plan, design, construct, operate and maintain the built environment undermines the wide-scale application of risk reduction principles in the construction sector.

Such in-depth analyses have been carried out in other sectors of the disaster risk reduction and management literature, but are uncommon. Kelman (2002; also Kelman and Spence, 2003), for example, examines the pathways through which flood-induced pressures differentially damages dwellings. He explores a wide range of variables, from the type of glass, glazing and features of windows through to the characteristics of dwellings' floors and foundations, roofs, doors and walls in identifying structural failure points. However, such analyses are relatively rare, with most discussions describing the role of the built environment in broad terms. While commentators such as Pelling (2003), for instance, recognise that weak buildings can increase vulnerability, few examine the precise characteristics of particular buildings that increase vulnerability, referring instead to generic categories, such as 'slum' dwellings, poorly maintained buildings or rental housing.

Individual vulnerability, collective risk: Risk as a covariate concept

Although most of the literature on disaster risk reduction recognises that vulnerability exists and often impacts at the individual and household level, it tends to be discussed and examined at the collective level (Alwang et al, 2001). Most discussions acknowledge that levels of vulnerability vary between individuals and households, and are mediated by the resources and capacities available to individuals and families. Keith Smith, for instance, argues that “within individual countries, regions, towns and streets, there are highly local variations in hazard exposure and in human vulnerability” (2001:25). More focused on capacities and coping, Hewitt argues:

Even vulnerability that appears in major disasters arises largely within the local, interpersonal and often domestic spaces of everyday life. Sometimes there can be quite striking differences in the ability to cope with and survive disaster within families. In this way, vulnerability raises the question of ‘micro-organisation’ and ‘micro-politics’, meaning human action and authority at the level of families, villages and neighbourhoods (1997:156)

However, research and practice often focuses on communities, geographical or administrative areas, or nations. The emphasis is often on covariate risks, or risks that affect entire communities such as earthquakes or cyclones (or, it is often argued, floods), as opposed to idiosyncratic risks, which affect individual households and include the loss of an earner, illness, dwelling fires or traffic accidents.⁹ The prevailing definition of ‘disaster’, for instance, emphasises large-scale human and physical losses. One of the most widely used definitions, adopted by the UNISDR, describes a disaster as:

A serious disruption of the functioning of a *community* or a *society* involving *widespread* human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UNISDR, 2009b:9, italics added).

The growing literature on the role of ‘everyday’ risks refocuses attention on, as Hewitt puts it, micro-organisation and micro-politics, but reducing and managing these risks continues to be discussed in aggregate terms, such as in the case of extensive risk or, as discussed earlier, with reference to ‘vulnerable groups’.

The exception is the famine and food security literature, which often takes a more individualised perspective. While the concept of vulnerability in the disaster literature as a whole is rooted in development theory explored by authors such as Sen (1981) and Chambers (1989; 1983), the food security literature is particularly influenced by

⁹ This definition of idiosyncratic and covariate risk comes from a literature review conducted by the Feinstein International Centre: Feinstein International Centre (no date). *Examining the Linkages Between Disaster Risk Reduction and Livelihoods*. Tufts University.

these ideas. Burg (2008) argues that the concept of vulnerability in food security approaches emerged from adaptations of Sen's work on famine, which looked to households to explain why famines occur even when there is food available (see too, Downing, 2005). Sen's analysis (1981) focused on households as the unit of analysis, and specifically the degree to which households' relative ownership of 'endowments' such as land, savings, rights to assistance and labour, enabled them to access food and other necessities. Given that such endowments - or human, economic and social assets - vary between households and even between individuals within them, vulnerability analysis in the food security literature generally emphasises individuals and households, rather than whole populations. In this context, Burg argues, "some of the key questions in vulnerability analysis thus revolve around how best to determine which people are more vulnerable, and why" (2008:611).

The emphasis on covariate risk is at least partly linked to the historical focus on acute events. Charlotte Benson and John Twigg (2007) argue that the emphasis on covariate risk is in large part due to the extreme, covariate nature of natural hazards. Acute "community shocks" (Gunther and Harttgen, 2009:1224) also undermine informal coping mechanisms developed by communities to deal with idiosyncratic risk, and affected people often require assistance from governments and humanitarian organisations (Hochrainer and Mechler, 2011). Moreover, there is frequently a communal component to risk due to the ties between individuals (Alwang et al, 2001). Betty Morrow (1999), for instance, argues that household level impacts spill over into communities. She provides an economic example: because poor communities rely heavily on the informal sector for employment, she argues that jobs often disappear when employers lose their homes or leave damaged areas.

In the case of flooding, the tendency to take a collective approach is in line with the broader focus in the flood-risk literature on its hydrological aspects. Events such as overflowing rivers, coastal flooding or storm surge are likely to affect large numbers of people in similar ways, undoubtedly making them covariate risks. As noted in a report on disaster risk and livelihoods, published by the Feinstein International Centre at Tufts University, which explicitly includes floods in its definition of covariate risk:

Covariate risk arises from hazards that tend to affect entire communities, such as drought, floods, or earthquakes and armed conflict. Such shocks [hazards] involve entire areas or sub-regions, destroying or depleting a range of livelihood assets, including natural and physical capital (no date:9).

However, the literature has not grappled with how to conceptualise the more developmentally-rooted flood-types discussed earlier – even though some of these are likely to be more idiosyncratic in their effects. While some types, such as artificial system failures, may result in collective impacts, flooding due to poor buildings or overflowing drains, for instance, falls firmly within the spectrum of ‘everyday’ risk and may play out at a much finer scale, affecting smaller numbers of people in more varied ways. These differences and their implications are rarely examined, and the literature continues to discuss flooding in primarily collective terms.

Broad strokes, complex matter: Summarising the conceptualisation of risk

Vulnerability is often discussed using broad brushstrokes. While most conceptual discussions on vulnerability recognise that it varies over time and space, between individuals and households, and according to the hazard involved, this complexity is often lost in sweeping generalisations about ‘vulnerable groups’ or the relationship between poverty and vulnerability. Rather than exploring the situations and dynamic processes that generate vulnerability in particular contexts, the literature often reduces vulnerability to static, and as Cannon (2008) argues, banal assumptions about who is vulnerable and the drivers of vulnerability. It is the poor who are seen to be most vulnerable, or particular types of people, such as single women or the elderly. This prevents a comprehensive understanding of risk and vulnerability, and of the dynamics driving vulnerability in particular settings and contexts. At best, this approach provides an indication of who may be vulnerable, but not why they are vulnerable or what can be done to make them less so; at worst it risks missing entirely people who fall outside of these categories.

The literature also tends to focus on the social drivers of vulnerability and often de-emphasises the role of other issues, such as features of the built environment. With the exception of the literature on seismic risk and earthquake protection, which recognises that the quality of buildings and their construction plays a crucial role in determining vulnerability, approaches to understanding risk often emphasise the social production of risk. While many commentators recognise that weak buildings can increase vulnerability, the causality is traced back to macro-economic and political processes. Moreover, while the literature on seismic risk often examines in detail the factors and issues that reduce buildings' ability to withstand earthquakes, very little of the literature from other sectors examines precisely what features increase vulnerability. As with the language of vulnerable groups, discussions frequently refer instead to generic categories, such as 'slum' dwellings, poorly maintained buildings or rental housing.

Finally, while much of the literature recognises that risk and vulnerability accumulate at the individual and household level, research and practice often discusses and applies these concepts at a collective level. Despite increasing emphasis on everyday risks, which occur at an individual and household level, the concepts of risk and vulnerability are applied coarsely; the emphasis is not on understanding what makes particular individuals or households vulnerable, but (often implicitly, rather than explicitly) on 'at-risk' populations of various sizes and kinds. This is very much the case with flooding. The literature on flood-risk tends to focus on large-scale, hydrometeorological events that are likely to affect large numbers of people, and has yet to interrogate the conceptualisation of potentially more idiosyncratic problems, such as flooding caused by poor buildings or overflowing drains.

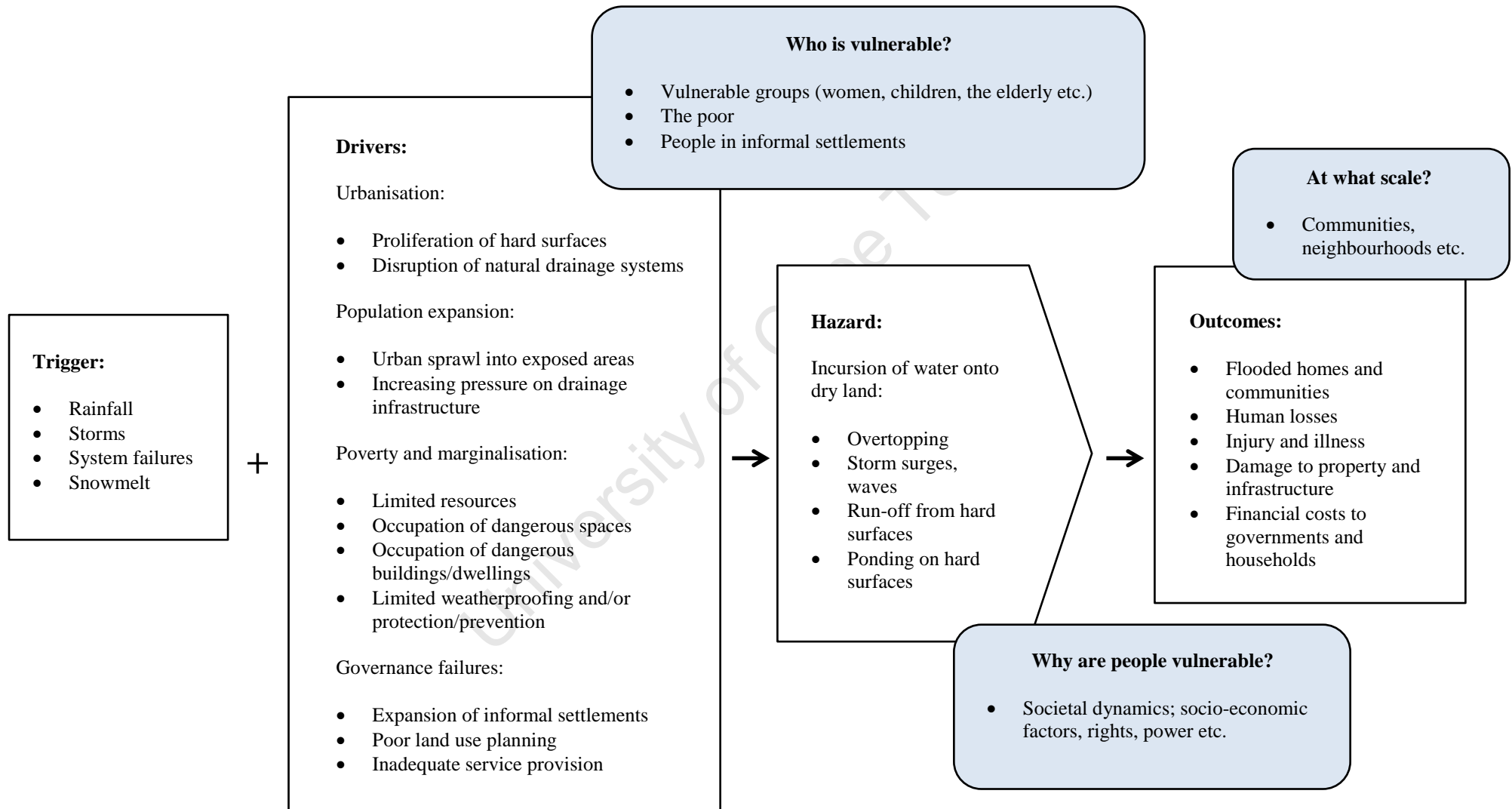
Figure 7 overlays schematically these discussions with the cause and effect pathways discussed in the previous section. It suggests that the international literature constructs risk, and flood-risk specifically, in very particular ways. In addition to constructing flooding, the hazard, in primarily hydrological terms, it often makes broad assumptions about who is most vulnerable and the factors driving vulnerability. While the theory emphasises process, context and the accumulation of risk at a range of scales, the literature often assumes not only that flooding is about weather and hydrology, but also that it is the poor and/or vulnerable groups (often in informal

settlements) that are most at risk, and that the impacts are felt at a collective scale. The literature also often emphasises the social drivers of risk, downplaying the role of the built environment.

This thesis interrogates these pathways and assumptions, and how well they capture people's experiences in subsidised housing areas in Cape Town. As discussed in Chapter 1, the thesis seeks to compare the empirical experiences of households living in both subsidised housing and informal settlements against prevailing constructions of flood-risk, and risk more broadly. Specifically, it examines four inter-related and overriding questions: when it comes to endangering flooding, what is it that households in flood-prone areas are vulnerable to? Who is most vulnerable to flooding? What factors drive vulnerability? At what scale does risk accumulate and how is it realised? The thesis examines the nature of the hazard, particularly whether endangering flooding on the Cape Flats is primarily an issue of too much water, triggered by atmospheric or other conditions. It explores whether endangering flooding primarily results in inundation, and whether it results in human losses and damage to property and infrastructure. Finally, it tests the assumptions made in both the domestic and international literature concerning the drivers of vulnerability, who is most vulnerable and the scale at which risk accumulates and impacts. In so doing, it examines how well prevailing constructions of flood-risk, and risk more generally, reflect the contemporary urban risk environment in developing countries such as South Africa, and what this suggests for theory and practice.

The next chapter examines the construction of risk in the South African literature and makes the case for examining flooding in subsidised housing areas in Cape Town. It describes the history and objectives of the government's subsidised housing programme, and the issues and challenges that may contribute to the risk of flooding in subsidised housing areas. It draws together the literature on housing and flood-risk to describe the rationale for research.

Figure 7: Summarising the construction of risk in the literature



CHAPTER 3

Promising a Remedy: Flood-Risk and Subsidised Housing in South Africa

Introduction

Research and practice frequently identifies informal settlements as sites of risk. As discussed in Chapter 2, discussions on flooding often focus on understanding and monitoring the physical, hydrological components of risk, but an emerging literature on risk in urban areas highlights a societal component rooted in underdevelopment. Proponents frequently focus on ‘vulnerable groups’ such as the poor, women or the elderly (Levine et al, 2012; Cannon, 2008; Wisner, 2001). Research on urban flooding specifically suggests that it is the poor who are most vulnerable, particularly those living in informal settlements, where dangerous locations, low-quality housing, inadequate or poorly maintained drainage infrastructure and limited service delivery leave them both particularly exposed to flooding, and amplify its impact (see Action Aid International, 2006; Pelling, 2003).

This is very much the case in Cape Town, where the provision of subsidised housing is frequently seen as the remedy for flooding. As illustrated in this chapter, both practitioners and the research community focus almost exclusively on informal settlements. Although few explicitly link disaster risk reduction and the provision of subsidised housing in the city, there exists an implicit but untested assumption that providing poor households with a formal brick and mortar dwelling addresses flood-risk. Flooding in informal settlements is widely acknowledged, anticipated and researched, but there has been virtually no research on people’s experiences in subsidised housing areas. It is simply assumed that formal housing eliminates flood- and other disaster risks.

One of my objectives in this thesis is to test the assumed relationship between subsidised housing and risk in Cape Town. I examine whether households living in subsidised housing are less impacted by severe weather and experience less flooding, and what this tells us about how risk is framed and understood in the literature more broadly. In testing the assumption that subsidised housing addresses risk, this thesis intersects discussions on the design, construction and quality of subsidised housing in South Africa. This literature, most of it from the development and housing sectors, suggests that dwellings are often poorly designed and built, lack basic weatherproofing, and are prone to leaks and damp. Many housing developments are also situated on marginal land that often floods.

This chapter examines the key issues identified in the literature on subsidised housing in South Africa. It draws together the discussions on urban flooding and housing to present the rationale for this research. The chapter begins by examining assumptions about flood-risk in subsidised housing areas, particularly those regarding housing as a solution to risk. It then explores the context for the study, including the aims and objectives of the South African government's housing programme. The chapter next explores weaknesses in the housing programme, and the issues that increase the potential for continued flooding in subsidised housing areas. Finally, drawing on both the literature on the weaknesses in government's housing programme and the nature of urban flood-risk locally (see Chapter 2), I make the case for exploring the extent, nature and impact of flooding in subsidised housing areas. I argue that the combination of high-risk locations and poor-quality dwellings suggests that flooding may remain a concern in subsidised housing areas. It raises questions as to whether subsidised housing solves flood-risk and suggests the need for research on flooding in low-cost housing areas.

Housing as development and risk reduction

Most research and practice concerned with flooding in poor urban areas in South Africa focuses on informal settlements. As discussed in Chapter 2, several authors have examined the nature and extent of flood-risk in informal settlements (for

example, Drivdal, 2011 a-b; Ziervogel and Smit, 2009; DiMP, 2008; Bouchard et al, 2007; DiMP, 2007). Applied research, primarily in informal settlements in the Western Cape, is extending how flooding in urban areas is understood. Few studies, however, have examined flood-risk in subsidised housing areas. This bias is not unique to South Africa. Illustrating the position in the global literature, Pelling and Wisner, for example, argue “the majority of those at risk from disaster in African cities live in informal settlements” (2008:52), while prominent publications by the UNISDR and others make the same point for settlements both within and outside Africa (for instance, Jha et al, 2012; World Bank 2011; UNISDR, 2009a; 2004; Wisner et al, 2004; Action Aid, 2006; Blaikie et al, 1994).

It is simply assumed that the provision of formal housing addresses not only developmental imperatives but also flood-risk. The government’s subsidised housing programme aims to address the spatial and socio-economic legacies of the Apartheid system. While tenure rights in informal settlements are insecure and ambiguous - they are usually illegal, but residents have *de facto* tenure rights by virtue of living on the land - it aims to provide households with tenure rights, and an asset that they can use to leverage additional resources (Govender, 2011; Charlton, 2009; Del Mistro and Hensher, 2009; Huchzermeyer, 2007).¹⁰ The elimination of informal settlements has become a priority for the government, with the authorities firmly of the view that “poor people will be saved by the benevolent state from the egregious indignities of living in shacks or slums or informal settlements” (Pieterse, 2009:13). It is implicitly assumed that, amongst the housing programme’s other objectives, the provision of housing eliminates rain-related flooding in high-risk areas. Discussing the City’s efforts to address flooding on the Cape Flats, Gina Ziervogel and Warren Smit, for instance, argue that, while the City has had limited success in proactively reducing risk, in the “long term, the intention is to upgrade all informal settlements (to provide

¹⁰ ‘Blacks’ have historically been afforded limited tenure rights in urban areas. Urban resettlement was a cornerstone of the Apartheid vision to reduce the size of the urban population of non-whites. Many were evicted from properties and forced into townships or resettled in primarily rural homelands, and denied urban residential rights. In urban areas, tenure rights were restricted in an effort to ensure only temporary residence. A black person could obtain permission to occupy land, but had no tenure rights over it. By the late 1970’s, non-whites were allowed to hold 99-year leases in township areas. By mid-80’s they could purchase new dwellings built by the private sector, and previous tenure arrangements could be converted into ownership rights in townships. Informal settlements, however, were and for the most part continue to be unauthorised and unplanned, and are often located on illegally invaded land (Royston, 2002).

security of tenure, facilities and full services) or, if unsuitable for upgrade, to relocate residents to formal housing projects” (2009:7).

People living in informal settlements prone to flooding share this view. Understandably, those living in informal dwellings tend to view the provision of subsidised housing as the solution to the range of challenges they face, including flooding, and government is under increasing pressure to deliver housing. As noted by a participant in recent protests on the Cape Flats, “we came here to ask that Sexwale [the Human Settlements Minister] build houses for us. It's not nice living in Barcelona [informal settlement] because we're constantly flooded” (Mtyala, 2012). A press release published by the Gugulethu Anti-Eviction Campaign following flooding in 2011 illustrates similar thinking at the community level:

The first thing we need is a formal dwelling (proper houses) in a serviced area. If we had this, there would be no more flooding in our communities and the City wouldn't even need to waste money managing disasters (Gugulethu Anti-Eviction Campaign, 2011).

Formal housing is thus seen as a panacea for flooding on the Cape Flats. For external commentators and affected communities alike, moving people out of informal settlements and into formal housing represents the long-term solution to the developmental issues driving risk. Given the focus on informal settlements, the experiences of those living in subsidised housing in South Africa have not been explored, and there has been virtually no research to test the assumption that subsidised housing addresses flood-risk. However, an extensive literature on quality concerns and other challenges in the government's housing programme suggests the need for such research. This literature, conducted primarily from an engineering, human geography and development perspective, points to serious flaws in the design and construction of many settlements and raises questions as to whether formal housing necessarily addresses flood-risk.

The next section examines the issues mediating the quality of subsidised housing in South Africa. It sketches the history and evolution of South Africa's subsidised housing programme, and some of the key challenges identified in its implementation.

It links to Chapter 5, which discusses the history and context of the research areas and sites, and aims to foreground and frame the examination of flood-risk in subsidised housing that follows.

Reconstruction and development: Subsidised housing in South Africa

This section explores the aims and evolution of South Africa's housing programme and the dynamics effecting housing delivery. It begins by discussing the ethos behind the subsidised housing programme, some of its achievements and constraints, and the shift in government's approach since the programme was launched in the mid-1990s. It then explores some of the key challenges faced by the housing programme since its inception, particularly with respect to redressing the inequalities of the past, the quality of housing and government's capacity to implement the programme.

Addressing the legacies of the past: The ethos and implementation of the programme

South Africa's housing policy is one of the government's most important redistributive programmes (Pieterse, 2009). It is estimated that at least ten percent of South Africa's 44 million people live in informal settlements nationwide (Misselhorn, no date). The provision of housing has been a key component of government's efforts to improve the lives of poor South Africans since it came to power in 1994. It has also become an important political imperative, as the authorities seek to "demonstrate delivery to an expectant post-democracy constituency" (Charlton, 2009:302).

The provision of subsidised housing has been a priority for government from the outset. The White Paper on housing, adopted by the African National Congress (ANC) government in 1994 sought to improve the lives of poor South Africans who, on their own, could not independently meet their basic housing needs (Human Settlements Department, 2009). It called for the creation of viable, socially and economically integrated communities, where all households could access opportunities, infrastructure and services (Human Settlements Department, 2009).

Housing was a key element in the government's Reconstruction and Development Programme (RDP), launched the same year. While the Programme's purview extended beyond housing, one component sought to address informality through the targeted provision of housing subsidies to qualifying low-income beneficiaries. The capital subsidy was initially limited to funding new low-cost turnkey housing developments – so called 'RDP houses' - but subsequently could also be used to fund individuals buying standing dwellings, the cost of building accommodation for rental by institutions, and the upgrading of hostels.¹¹ It could also be used for self-help construction on fully serviced sites, referred to as the People's Housing Process (PHP) (Del Mistro and Hensher, 2009), with the PHP providing, in practice, the main alternative to the dominant contractor-built turnkey housing associated with the government's housing programme.

The RDP programme provided a huge number of houses in a relatively short time. The post-1994 government set and achieved an ambitious target of delivering one million houses in its first five years in office (Del Mistro and Hensher, 2009). Commenting on housing provision between 1994 and 2000, Alan Gilbert (2004) argues that although the subsidy programme failed to solve South Africa's housing problem, it provided homes to very large numbers of poor households. He argues that:

No other country has ever been able to do so much over the first 5 years of its programme. And, given the widespread disappointment with the achievements of the first ANC [African National Congress] government, some consider housing to be one of the few success stories (2004:19).

Despite these successes in delivery, the RDP programme was widely criticised. An evaluation by the Public Service Commission, for instance, highlights the problems of poor location, poor-quality housing and the creation of unsustainable urban environments (2003, cited in Smith, 2008). The programme was also criticised for entrenching Apartheid geography. Rather than addressing the inefficient and

¹¹ Hostels in South Africa refer to dormitory-type accommodation. Historically, hostels housed primarily male workers, who were prevented from bringing with them or living with their families by the Apartheid government's Group Areas Act. They were particularly associated with South Africa's mines, but were also used by other employers.

inequitable spatial patterns that are the legacy of Apartheid, commentators argue that the subsidy programme further marginalised the poor (for example Del Mistro and Hensher, 2009; Pillay, 2009; Smith, 2008; Huchzermeyer, 2007; 2003; South African Cities Network, 2006). Marie Huchzermeyer argues that massive, standardised housing projects perpetuated segregation by income group, “allocating the most disadvantaged urban/peri-urban locations to the poorest sectors of society...in places where no high income earner will wish to locate” (2003: 130). This was at least partly due to the difficulties of obtaining land for development. Writing on Cape Town, Ivan Toruk argues:

...the developers of subsidised housing are forced into the southeast periphery because land is unaffordable elsewhere. So, the poor are being excluded from the prosperous city core and suburbs through the operation of the land market. The general implication is that income, social class and market forces have replaced race and state control in directing the pattern of urban development (2001:236).

These problems led to a refinement of the government’s approach to subsidised housing. The RDP initiative was replaced in 2004 by government’s Comprehensive Plan for Sustainable Human Settlement, referred to as the *Breaking New Ground* (BNG) plan. This seeks to develop integrated and sustainable human settlements, and emphasises the ‘triple bottom line’ concerns of environmental sustainability, shared economic growth and social inclusion (Boraine et al, 2006). It incorporates several new focus areas including an Upgrading of Informal Settlements Policy (UISP); social housing, promoting more communal, medium-density housing options such as flats, group-housing and hostels; and rural housing (Department of Housing, 2004).

The UISP was incorporated into the National Housing Code in 2004. It emphasises the eradication of informal settlements through phased, in-situ upgrading in locations suitable for development, and relocation to greenfield sites in areas where development is not possible or desirable, such as areas prone to flooding or with unfavourable soil conditions (Department of Housing, 2004). Wherever possible, however, the UISP aims to upgrade settlements in-situ. The goal is to develop flexible, responsive housing through a three-phase process. This comprises planning and

assessing the physical characteristics and infrastructural needs of the site; the provision of services, community amenities and secure tenure; and, finally, the construction of housing in response to community demand, including medium-density housing and free-standing houses constructed by contractors, mutual aid and community self-help (Department of Housing, 2004). It is being tested in nine pilot projects, the most visible being Cape Town's N2 Gateway Project.

The PHP continues to provide the main alternative to dominant contractor-built turnkey housing built under the UISP or earlier housing models. Under the programme, non-governmental organisations (NGOs) in the housing sector work with communities to plan and build their own homes. Instead of going to contractors, the subsidy is paid to vetted Support Organisations that administer the funds and provide logistical and administrative support. Beneficiaries were initially required to build their dwellings using their own labour, or 'sweat equity', but in 2008 the government extended the definition of self-help and subsidies may now be used to employ contractors (Himlin, 2008) - although in practice, many PHP beneficiaries already used local builders prior to this policy shift (Bolnick, 2009).¹² The underlying premise is that individuals, families or groups can "get more for less" (Human Settlements, 2009:18) from their subsidy, while also having more control over how the money is used. Perceived benefits of the PHP include more individualised, context-appropriate developments and improvements in quality, as beneficiaries have a vested interest in ensuring their dwellings are well built.

Persistent inequalities and poor-quality: Weaknesses in the delivery of subsidised housing

Despite the government's efforts to address the weaknesses in the subsidised housing programme, it continues to perpetuate many of the spatial inequities of the Apartheid era. Edgar Pieterse (2009) argues that many municipalities have been "playing a desperate game of keeping up with the pressure from national government to provide

¹² The 'sweat equity' concept is controversial, and has been criticised for limiting the access of constituencies such as female-headed households to the PHP (see Ndinda, C. (2004). 'Sweat Equity': Women's participation in subsidised housing in South Africa. *Africa Insight*, vol. 34, no. 2/3, pp. 58-64). As discussed later in this section, commentators have also raised concerns with respect to beneficiaries' capacity build their own home.

as many housing ‘opportunities’ as possible within budgetary provisions” (2009:8). Despite the goals of the BNG strategy, this pressure has over-ridden opportunities to spatially integrate South African cities. As Pieterse argues:

Given the scale of these programmes, and the input planning that is required to identify and service land, award contracts to private developers to build, negotiate a contested waiting list, and maintain these assets once they come on stream—when most of the inhabitants do not have the incomes to pay for the services or maintain the houses—it is inevitable that the imperatives of public housing dominate urban development practice. In the face of the political pressure to keep these programmes growing, it is equally predictable that there is little capacity or energy to understand and deal with the unintended consequences of sprawl, depreciating stock because of the inability of residents to maintain their dwellings, the widespread informal trading of the housing...In effect, as quickly as these housing settlements arise from the ground, they compound, at a larger scale, the unsustainability, inefficiency and fragmented nature of the city-region (2009:8).

Moreover, while the BNG espouses both more creative, responsive housing solutions and the holistic development of community infrastructure, most housing still conforms to the basic ‘RDP’ model. Andrea Bolnick, for instance, argues that:

The Upgrading of Informal Settlements Policy has not been adequately put into practice and translated into changed delivery on the ground...The de-facto policy approach has therefore remained one which is focused primarily on the provision of conventional housing i.e. a house + related services + title as a fixed package. Instead of using the flexibility and space that this policy allows to find innovative solutions that translate into action on the ground many municipalities have utilized the UISP and BNG funding to fast-track subsidies for conventional projects (Bolnick, 2009:4).

In many cases, developments continue to comprise uniform, closely packed, box-type houses. Neighbourhoods are frequently poorly planned with inadequate attention to layout, density, and the general utilisation of space. Most subsidised housing-stock comprises small, single-story freestanding dwellings, frequently separated only by narrow corridors (Bolnick, 2009).¹³

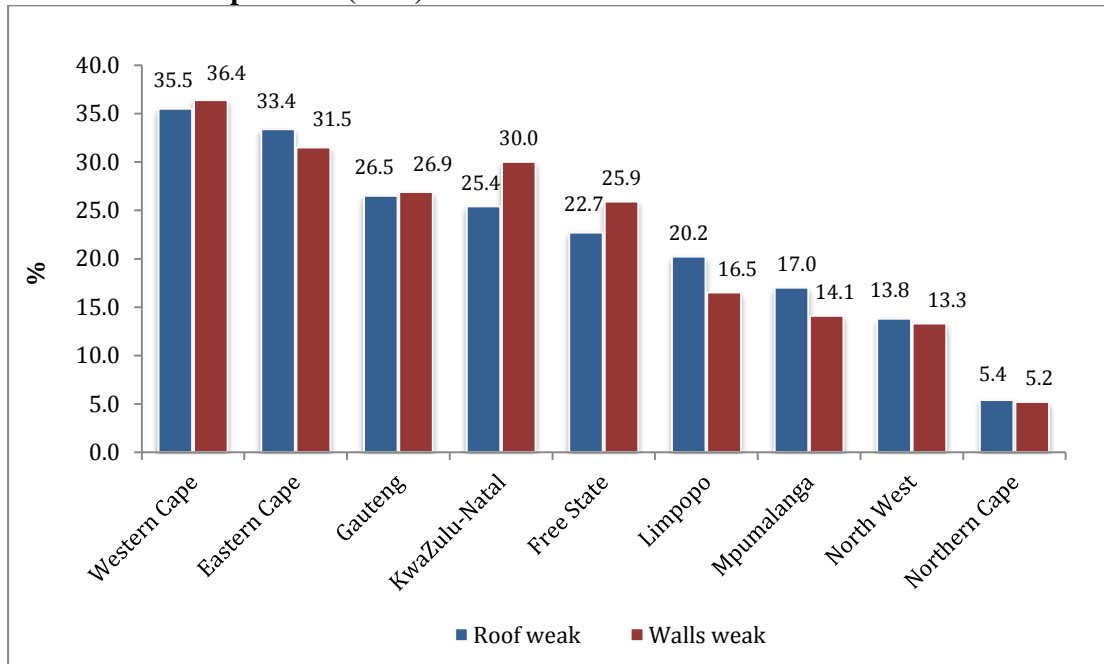
The quality of housing also remains a challenge, with dwellings frequently criticised for being too small, poorly constructed and badly finished (Charlton, 2009; Gilbert, 2004). Most pertinent to this thesis, numerous studies have highlighted problems of build-quality. For example:

- A recent survey of 322 households in four subsidised housing developments in Driftsands, Greenfield, Masiphumelele and Tafelsig, in Cape Town (Govender et al, 2011) found that the majority of beneficiaries reported one or more structural problems. These included large, visible cracks in the walls, damp and the absence of plastering, which allows water to penetrate during storms.
- Research among 120 beneficiaries in four settlements in Johannesburg, in Gauteng province, also found that units were neither painted nor plastered, the walls in many were cracked, and ventilation was poor, with buildings cold in the winter and hot in the summer (Aigbavboa and Thwala, 2011).
- Research in the Eastern Cape province found that, in addition to structural cracks, doors frequently did not fit their frames securely, allowing water in during storms, foundations were frequently cracked and floor-slabs were frequently inadequately waterproofed (Ngxubaza, 2010).
- Data from Statistics South Africa's (StatsSA's) 2008 General Household Survey also highlights problems, particularly in the Western Cape. One out of every three

¹³ The UISP has made advances towards achieving the reduction of poverty, vulnerability and social exclusion in South Africa (Huchzermeyer, 2007). In situ upgrading recognises and supports, for instance, the livelihood needs and other preferences of the poor, particularly the imperative of living closer to economic opportunities. It also entails less disruption to beneficiaries lives (Goebel, 2007). For a comprehensive review of the dynamics surrounding the UISP, see Ziblim, 2013. Also see, for example, Bolnick, 2009; Del Mistro and Hensher, 2009; Misselhorn, 2008; Huchzermeyer, 2007.

households living in subsidised housing in the province reported that their roofs and walls were ‘weak’ and in need of major repairs (Figure 8), while an additional one in ten reported that their roofs (12%) and walls (13%) needed minor repairs.

Figure 8: Proportion of subsidised housing beneficiaries reporting ‘weak’ roofs and walls in each province (2008)



Source: General Household Survey 2008, StatsSA

The quality issues are not confined to contractor or developer-built housing. Although one of perceived benefits of the PHP is improved build-quality, research shows that many dwellings show similar problems. Research amongst a small sample of 23 PHP dwellings in Gauteng, for instance, found that more than half had some kind of defect, including cracked foundations or walls, leaking roofs and walls, or roof trusses that were not straight (Ogunfitimi, 2008). The study attributed most of these problems to poor levels of supervision by building inspectors and inadequate training of beneficiaries, either in building or supervision skills. A larger study comparing the quality of 200 contractor-built and 200 PHP-built homes in the Free State province found quite differentiated outcomes (Ntema, no date). When asked how satisfied they were with their dwellings, respondents in PHP-built homes tended to cluster at either end of the scale (either very satisfied or very dissatisfied) while those in contractor-built housing lay in between (Table 2).

Table 2: Levels of satisfaction with the build-quality of contractor and self-help dwellings in the Free State (n=400)

	Contractor-built	Self-help
Very satisfied	0.1	24.4
Satisfied	38.7	16.6
Undecided	1.6	4.7
Dissatisfied	56.6	16.6
Very Dissatisfied	2.6	37.8

Source: Ntema, no date

The consequences of structural defects can be severe. Leaks and the build-up of condensation can lead to degradation of building structures. Damp can also cause discomfort and encourage the growth of mould, which is frequently associated with allergies, respiratory infections and other illnesses (Govender et al, 2011; Mathews et al, 2002). In immune-compromised people and people with chronic lung or other diseases, exposure to mould can cause serious, life-threatening lung infections (National Centre for Environmental Health, 2010). Agrément South Africa argues that although medical opinion on the dangers of chronic damp varies widely due to a lack of suitable statistical data, given the potentially severe consequences, builders must ensure that there is no damp visible on the inside face of external walls in buildings meant for human habitation (Agrément South Africa, 2002a; 2002b).¹⁴

High demand, limited capacity to supply: The macro-political and economic challenges facing the housing programme

Many of the problems identified in the government's subsidised housing programme, and particularly the quality concerns, are linked to issues within South Africa's broader economic and political context. Central among these is the demand for housing. By the end of 2011, the government had added another two million units to the 1 million built during the first five years of the housing programme. With a

¹⁴ Agrément South Africa independently assesses and certifies non-standardised construction products, systems, materials, components and processes for the construction sector. It works alongside the South African Bureau of Standards (SAB), testing and certifying products, processes and systems not covered by the SAB.

backlog of well over two million units inherited from the previous government, however, and continued population growth, the need for housing has outpaced its supply (Financial and Fiscal Commission, 2012). The situation in Cape Town follows the national trend. It is estimated that the housing backlog almost doubled between 1999 and 2006, from 150 000 to 265 000 units, with the City only managing to deliver just over 19 000 units between 2001 and 2004 (City of Cape Town, 2006). More recent estimates put the backlog at between 360 000 and 400 000 units, with the housing deficit growing at a rate of 8 000 to 16 000 units per year (Mongwe, 2010). This delivery gap places considerable pressure on government to provide housing as rapidly as possible, often at the expense of quality (Gilbert, 2004).

This lack of resources reduces the quality of dwellings. In response to beneficiary dissatisfaction with the size of dwellings (Tomlinson, 2008; Gilbert 2004), government increasingly pushes developers to build houses that are as large as possible within the confines of the available subsidies. This move by the authorities to obtain as much bang for their buck as possible has reduced the profit margins for developments, resulting in many contractors cutting corners in order to ensure that projects remain profitable (Wust, personal communication, November, 2010). In this vein, the Isandla Institute argues that, in the absence of increases in the size of subsidies over time, “it has become increasingly difficult for authorities and developers to deliver an acceptable product” (1999, cited in Gilbert, 2004:21). Resource constraints also impact in other ways. Comparing actual and budgeted capital and operating costs, Pieterse (2009) argues that local authorities throughout South Africa lack the resources to implement and manage housing projects and the associated investments in infrastructure. He argues that housing projects frequently create operating expenses which local authorities have neither the tax base to service, nor sufficient transfers from national government to cover. He observes:

...within a larger political discourse of “avoiding the roll-over of public funds for the poor”, municipalities are pushed very hard to simply invest, build and expand with no clue about how they will cope with the maintenance price tags associated with these processes (2009:8).

In Cape Town, insufficient financial and human resources have served to hamstring delivery. In a review of Cape Town's development plan, the authorities note that the City receives only enough funding to deliver 7 500 housing units per year, with delivery falling short of this figure due to a "lack of sufficient technical, planning, financial and social facilitation capacities" (2008, cited in Ziervogel and Smit, 2009:7). Identifying and purchasing land for new settlements remains an ongoing challenge (Ziervogel and Smit, 2009), with many housing projects stalling either because land is unavailable or, in the case of private land, owners refuse to sell at the prices offered by government.

The pressures of rapidly rising demand are exacerbated by limited institutional capacity. Although levels of capacity vary widely between municipalities in South Africa (Tomlinson, 2011), many experience acute capacity constraints (Fatti and Patel, 2012; Pieterse, 2007). Municipal structures in Cape Town have been repeatedly restructured over the last 15 years, and there has been ongoing rationalisation of municipal staff. Between 2000 and 2006, for instance, the number of employees working for the City of Cape Town fell from 27 000 to 22 000 (Ziervogel and Smit, 2009). The implications of these cut-backs are illustrated by the City's water and sanitation directorate where, in 2006, a single individual oversaw the roll-out, servicing, upgrading and maintenance of water and sanitation infrastructure in all of the city's informal settlements (Wood, personnel communication, 2006). Such capacity constraints hamper implementation of the housing programme at the local level, particularly when combined with the demands of the BNG strategy which, Tomlinson notes, "requires complex demand-driven processes to be carried out and therefore a much more sophisticated institutional response on the part of local government, than was previously the case" (2011:420).

In many cases, provincial authorities have stepped in to fill this breach, but rather than improving delivery, this has frequently added to challenges effecting the subsidised housing programme. Tomlinson (2011) argues that the blurring of responsibility between provincial and local government has left municipalities responsible for housing projects and related infrastructure, while simultaneously stripping them of the authority to manage them. Where provinces carry out tender processes and appoint contractors, for example, local authorities frequently have little or no authority to hold

these appointments accountable when they underperform.¹⁵ Prior to 2009, this situation was further complicated in Cape Town by political infighting between the provincial and local governments, controlled by the African National Congress (ANC) and the Democratic Alliance (DA) respectively.

These dynamics have served to undermine the implementation of the housing programme. There have been successes, but the programme has failed to fundamentally shift prevailing spatial inequalities in cities like Cape Town and, as discussed further in Chapter 5, the physical and social marginalisation of the urban poor remains largely unchanged. Despite government's efforts to address these weaknesses, in many cases subsidised housing continues to be built on marginal land; dwellings are often poorly built; and resource and capacity constraints frequently limit oversight, monitoring and quality control within the sector. Thus, although the housing programme has undoubtedly improved the lives of many poor families, beneficiaries are frequently handed the keys to poorly situated, substandard dwellings.

High ideals, flawed process: Summarising the purpose and implementation of the housing programme

In summary, the South African government views the subsidised housing programme as a mechanism to address poverty and correct the highly inequitable spatial and physical landscape in many areas (Pieterse, 2009). The subsidised housing programme aims to provide low-income households with homes by providing subsidies to help build or purchase entry-level housing. Under the RDP programme, the capital subsidy was most frequently used to fund new, contractor-built, low-cost turnkey housing developments, with the main alternative being the PHP, under which beneficiaries could use the subsidy to self-build dwellings on serviced sites (Del Mistro and Hensher, 2009). Although the RDP programme achieved impressive

¹⁵ Under the South African constitution, housing is a national and provincial competency. However, the Housing Act of 1997 specifies that local authorities must, as part of their development planning processes, ensure that people in their jurisdiction have adequate access to housing and services, and provides for national and provincial government to devolve these responsibility to the local level. In practice, local government has generally assumed responsibility for housing, with the BNG stipulating that municipalities should assume overall responsibility for housing programmes and that provincial and national government delegate accordingly responsibility and resources to local government (Tomlinson, 2011).

numerical targets, however, it frequently failed to live up to its developmental potential. The government was criticised for building dwellings in poor locations, the low-quality housing and for creating unsustainable urban environments (for example Del Mistro and Hensher, 2009; Pillay, 2009; Smith, 2008; Huchzermeyer, 2003; South African Cities Network, 2006).

In response to these problems, and concerns over the RDP's failure to redress the legacies of Apartheid, the programme was replaced by the BNG in 2004. This emphasises the development of integrated and sustainable human settlements, and incorporates several new focus areas (Boraine et al, 2006; Department of Housing 2004). The most pertinent of these is the UISP, which aims to eradicate informal settlements either through phased, in-situ upgrading or, where land is unsuitable for redevelopment, relocation to greenfield sites. The BNG continues to include a PHP component. This remains the primary alternative to contractor-built housing options, and aims to help beneficiaries to get more for less by building dwellings themselves (Bolnick, 2009; Human Settlements, 2009).

Despite the government's attempts to address the weaknesses in the housing programme, substantial challenges remain. The BNG strategy promotes more flexible and creative housing options, but most new developments continue to comprise uniform, closely packed, RDP-type houses. Settlements are frequently poorly planned, with inadequate attention to layout, density and the use of space. Quality also continues to be a persistent problem. Research in contractor-built settlements over the last decade shows that many dwellings are poorly constructed and badly finished. Most pertinent to the flooding issue, dwellings frequently show structural flaws in their roofs, walls and floors; lack basic weatherproofing, such as plastered walls; and are prone to leaks. It is hoped that involving beneficiaries in planning and building their dwellings improves quality of housing, but there is evidence to suggest that dwellings built under the PHP also experience problems, although it is unclear how prevalent these are compared to contractor-built settlements.¹⁶

¹⁶ Although separated in policy, in practice the physical differences between RDP, PHP and housing built under the BNG are less marked. RDP developments are typically highly standardized, single-story 'box-type' dwellings. BNG allows for more variation, including flats and other types of social housing, although settlements often appear similar to RDP housing. PHP settlements are more variable, showing

The weaknesses in the housing programme reflect a range of macro-economic and political dynamics. These include the pressure on government to build dwellings in the face of large housing backlogs and expanding demand, and the limited human and financial resources available to implement, manage and monitor the programme. These resource and capacity constraints frequently limit oversight, monitoring and quality control within the sector. These challenges have not only served to impede the delivery of high quality housing, but have also undermined the developmental objectives of the housing programme. While there have been successes, the programme has failed to address the physical and social marginalisation of the urban poor.

The combination of poor-quality housing and the continued marginality of settlements and beneficiaries raise questions as to whether subsidised housing reduces flood-risk. Given that settlements in Cape Town are frequently built on marginal land, it is probable that many developments are located in sites that are prone to flooding during winter. This is unlikely to be a problem in well-designed, well-built settlements developed with local conditions in mind, but could leave households vulnerable to flooding where developments and dwellings are poorly built and designed. This is particularly the case in low-lying areas prone to seepage, where poorly constructed foundations, for example, could allow groundwater into dwellings. However, neither the literature on housing nor the literature on flooding has explored adequately the possible connection between the quality of subsidised housing and flood-risk.

A neglected constituency: Flooding in subsidised housing areas

There is a growing body of knowledge on endangering flooding in informal settlements, but there remains a gap: the experiences of those living in formal housing in poor areas. As examined in Chapter 2, both international and South African research on urban flooding has helped to deepen and nuance how flooding is

a range of housing plans depending on beneficiaries' preferences and the advice of the Support Organisation (see Appendix 6 for images illustrating the different housing types).

conceptualised in towns and cities, but there is very little literature on the nature and extent of flood-risk in poor, but formal areas. It is simply assumed that households living in urban informal settlements are most vulnerable to disasters generally and flooding, in particular. By extension, it is assumed that flooding is not a challenge in subsidised housing areas although, as noted earlier, few explicitly link the two. This assumption remains largely untested.

The paucity of information on the experiences of households living in subsidised housing locally, as well as the bias towards the experiences of those living in informal settlements, highlights a major gap in how risk is conceptualised. It suggests that, by situating flood-risk entirely within informal settlements, City authorities and the research community might fail to identify continued vulnerability in subsidised housing areas. This stands to undermine the objectives of the housing programme and prevents a more comprehensive and accurate understanding of flood-risk on the Cape Flats. The emphasis on informal settlements in the international literature also points to a major gap in how we construct and understand risk in more general terms – a gap that needs filling if we are to understand holistically the nature and parameters of contemporary urban risk in developing countries.

There is some evidence of flooding in subsidised housing areas. Two studies in the Western Cape, one by the Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) (2003) and another by Ameen Benjamin (2008), suggest that flooding is a challenge. The former, a post-flood assessment in Montagu, did not focus on subsidised housing, but showed that households living in poor formal areas were severely affected by flooding. The research found instances of walls and roofs collapsing, and indicated extensive damage to households' belongings due to leaks and the in-flow of floodwater (DiMP, 2003). Benjamin's research (2008) also found that dwellings in both informal and subsidised housing areas were affected by heavy rain in George.¹⁷ His study focused on the nature of the flooding and households' ability to absorb the impact of severe weather events, rather than on the specific state and drivers of vulnerability, but is nevertheless instructive. He found that poor

¹⁷ Benjamin's research drew on an earlier post-flood evaluation carried out by DiMP in 2007 (DiMP, 2007).

enforcement of building standards, planning failures and insufficient weatherproofing increased the likelihood of flooding in subsidised housing areas.

These findings, when read alongside the well-documented weaknesses in the South African government's housing programme, suggest the need to examine flood-risk in subsidised housing settlements. While practitioners, researchers and communities living in flood-prone informal areas assume that the provision of housing addresses flood-risk, this literature suggests that flooding may remain a problem in subsidised housing areas. Rather than remedying flood-risk, poor-quality housing may serve to perpetuate vulnerability. Given the emphasis on subsidised housing as not only a developmental strategy but also as a mechanism for reducing risk, it is essential to better understand whether this is the case and, if so, the drivers of vulnerability and what can be done to address them.

Sites of risk: Summarising the case for flooding in subsidised housing settlements

The literature on subsidised housing makes a strong case for examining flooding in subsidised housing areas in Cape Town. Discussions on the flaws in the subsidised housing programme indicate that settlements and dwellings are frequently poorly designed and constructed. Many subsidised housing settlements are also built on marginal land, potentially prone to flooding. This is unlikely to be a problem if dwellings are well designed and built, but the combination of high-risk locations and poor-quality housing may serve to perpetuate flood-risk in poor formal areas.

Despite these suggested linkages, very little is known about flooding in subsidised housing areas. Both international and local research on urban flooding has helped to deepen and nuance how flooding is conceptualised in towns and cities, but very few studies have explored the nature and extent of flood-risk in poor, but formal areas. It is simply assumed that households living in urban informal settlements are most vulnerable to disasters generally, and flooding in particular. However, the few studies that have explored flooding in subsidised housing areas suggest that flooding may remain a challenge.

This thesis aims to fill this gap, with a view to better understanding flood-risk in the local context, and the implications for the construction of risk more broadly. The next chapter presents the research methodology and approach, and the rationale behind the different methods and tools. It examines how the research sites were selected, explains the research instruments and the types of data collected, and discusses the limitations of the research and how these were addressed.

University of Cape Town

CHAPTER 4

Assessing Flood-Risk in Subsidised Housing and Informal Settlements on the Cape Flats

Introduction

The methodology aimed to test prevailing assumptions about flood-risk, and the chain of causality implied in international discussions on flooding, and risk more broadly. Drawing on the theoretical discussions explored in Chapters 2 and 3, my research examined how well prevailing assumptions about the nature and consequences of flooding capture the experiences of households living in subsidised housing in Cape Town. Drawing on the flood typologies suggested in both international discussions on flooding and research on urban flooding in South Africa, it examined the nature of the hazard. In particular, whether flooding on the Cape Flats is primarily an issue of surplus water, triggered by atmospheric or other conditions. The study also examined the nature of realised risk, the drivers of vulnerability and the scale at which risk accumulates and plays out. As discussed in Chapter 1, overall the research examined four inter-related and overriding questions:

- What is it that households in flood-prone areas are vulnerable to?
- Who is vulnerable to flooding?
- What factors drive vulnerability?
- At what scale does risk accumulate and how does it manifest?

I also explored how the experiences of households in subsidised housing and informal settlements compare. As explored in Chapters 2 and 3, discussions on risk and urban flooding often focus on vulnerability in informal housing areas. This is particularly so in Cape Town, where the authorities, the research community and those living in

flood-prone settlements assume that flooding is confined to informal housing areas. The extensive literature on the often poor quality of dwellings and the physical marginality of developments makes a strong case for flooding in subsidised housing developments, but very little is known about the extent, nature and impact of flooding in these settlements. In this context, I sought to test empirically the assumption that informal settlements are most vulnerable to flooding and, with reference to Cape Town specifically, whether the provision of housing addresses flood-risk.

This chapter details the research methodology and approach, and the purpose of the different methods. The chapter begins by drawing the links between the theory and the approach and methods used. It discusses the specific questions guiding the research, before providing a brief overview of the methodology. It then examines how the research sites were selected and explains the research tools and types of data collected. It also discusses the limitations of the research and how these were addressed.

Connecting the theory and methods

As explored in Chapters 2 and 3, the literature on flooding and urban flooding implies certain causal pathways. Discussions on flooding often focus on its hydrological aspects. In typical explanations rain, storms or melting snow raise water levels in rivers, streams and other waterbodies, or cause storm surges or coastal flooding. This leads to water flowing onto land that should be dry. Research in urban areas in developing countries extends the parameters of flooding, but it remains conceptualised primarily in terms of surplus water and inundation. This literature shows that flood-risk is often embedded in developmental issues such as rapid or poorly managed urban expansion. These serve to translate hazard events into unsafe conditions, such as settlement in dangerous spaces and places exposed to flood-hazards. Flooding takes on new forms such as overflowing drainage infrastructure and run-off from hard surfaces. The outcomes include deaths, flooded dwellings and damage to property and infrastructure.

Research in the Western Cape identifies additional types of flooding. These include ‘rising flooding’ or seepage due to the high water table on the Cape Flats, the persistent accumulation, or ponding of water in low-lying areas, and the expansion of settlements into wetlands and detention ponds (Drivdal, 2011 a-b; Armitage et al, 2010; Bouchard et al, 2007; Dixon and Ramutsindela, 2006). Studies also identify flooding resulting from leaks in poorly constructed roofs, walls and doors (Benjamin, 2008).

There are a range of assumptions underlying this conceptualisation of risk. Discussions often focus on ‘vulnerable groups’ such as women, the elderly, ‘the poor’ and those living in informal settlements. This is particularly so in Cape Town, where research and practice focus almost exclusively on risk in informal areas. Commentators frequently focus on the social drivers of vulnerability and risk, and emphasise socio-economic, macro-political and governance issues. They also tend to conceptualise flood-risk at a collective, or covariate level.

I sought to explore these pathways and assumptions and how well they reflect the experiences of people living in flood-prone communities on the Cape Flats. Drawing on the discussions in explored in Chapters 2 and 3, I sought to test the overarching research question of whether the provision of subsidised housing addresses flood risk, and how the experiences of formal and informal households compare, with the research which was conducted in an equal number of informal and formal settlements. In so doing, I aimed to test existing beliefs about the nature of flooding, who is vulnerable, the sources of vulnerability and how risk manifests. Restating the chain of causality discussed already, I sought to interrogate four questions. The first was whether flooding occurs only in informal settlements. The second was whether flooding on the Cape Flats is primarily hydrometeorological in nature and whether river flooding, seepage, run-off, ponding or other types of urban flooding are the foremost concerns. The third was what mediating factors drive vulnerability and risk. The fourth was to what extent flooding results in flooded dwellings and communities, human losses and damage to property. Table 3 summarises these assumptions and their associated research questions.

I adopted a multi-dimensional perspective. As explored in Chapter 2, commentators increasingly recognise that risk has geophysical, societal and institutional components. In line with prevailing approaches, I examined flooding from a geographical, socio-economic and physical perspective. I also explored the role of factors such as people's knowledge and implementation of measures to address flooding, as well as levels of governmental assistance in preventing or responding to flooding. I focused on the dynamics driving risk at the community or area-level, but I also examined more general macro-level factors such as governance dynamics, although in less depth. These included levels of oversight and monitoring in the housing programme and standards in the construction industry. Table 4 summarises the dimensions and issues explored.

A specific effort was made to avoid pre-judging the nature of the hazard, the drivers of risk or the impact of flooding on households. As discussed in the next section, the research took an iterative approach. Rather than selecting sites immediately I began with qualitative research. This included a series of preparatory interviews with key informants aimed at identifying research sites. Within each site, I conducted interviews, focus groups and understood guided walks through each settlement, with the purpose of identifying the issues to be explored during the course of the study and types of flooding. This data laid the basis for more extensive quantitative and spatial analyses. Although the literature on flooding tends to focus on river and flash flooding, and with respect to Western Cape specifically, 'rising flooding', an effort was made not to predetermine the parameters of the hazard. Respondents were only asked initially whether people in the settlement experienced any problems when it rained, with the nature and extent of issues unpacked over the course of the discussion. In addition to the more general methodological advantages of a mixed qualitative, quantitative and spatial approach discussed below, this iterative research process aimed to avoid possible biases in the conceptualisation of cause and effect.

The next section provides a brief overview of the research methodology. It describes the different research tools, the research process, and the analytical approach. It also discusses the rationale for using different research tools, and how they fit together.

Table 3: Summary of assumptions tested, empirical and research questions guiding the research

Issue	Conceptual assumptions in the literature	Empirical questions	Research questions
The nature of the hazard	<ul style="list-style-type: none"> • Flooding concerns surplus water • Flooding in Cape Town takes the form of ‘rising’ flooding, overflowing waterbodies or drainage infrastructure, run-off from or ponding on hard surfaces 	<ul style="list-style-type: none"> • What types of flooding are experienced in informal and subsidised housing areas in Cape Town? • To what extent do topographic or geographic factors influence households’ experiences of flooding? 	<ul style="list-style-type: none"> • What types of flooding do households experience? • What triggers flooding? • What forms are the most common? • Do households in subsidised housing experience the same kinds of problems as those in informal settlements? • Do households located close to waterbodies experience more flooding? • Do dwellings in low-lying areas experience more flooding? • Do households close to drainage infrastructure, slopes, roads, paths, or other potential run-off points experience higher levels of flooding?
How flooding manifests	<ul style="list-style-type: none"> • Flooding results in some degree of inundation 	<ul style="list-style-type: none"> • How does flooding manifest? • Does flooding result in flooded dwellings and communities and damage to property and infrastructure? 	<ul style="list-style-type: none"> • How do the types of flooding experienced in Cape Town impact physically on households? • Does flooding usually result in flooded dwellings and communities or are the effects felt differently? • What forms have the greatest impact?
Who is vulnerable	<ul style="list-style-type: none"> • Households in informal settlements are the most vulnerable to flooding • Households in subsidised housing do not experience flooding • It is the poorest and/or the most marginalised who are the most vulnerable 	<ul style="list-style-type: none"> • Are households living in subsidised housing less likely to experience flooding than those in informal settlements? • Do some households experience more flooding than others or are some more impacted than others? • What makes the difference? 	<ul style="list-style-type: none"> • Do households in subsidised housing experience flooding? • What are the costs to households in financial terms and what are the implications in the longer term? • What are the costs to households in terms of health and quality of life? • Does flooding have the same implications for those in subsidised and informal housing? • What are the factors driving vulnerability and risk? • What sets households experiencing flooding apart?

Issues of scale	<ul style="list-style-type: none"> • Flooding plays out at a collective level 	<ul style="list-style-type: none"> • Are households in particular communities and/or locations equally prone to flooding? 	<ul style="list-style-type: none"> • Do households in particular communities experience similar levels and types of flooding? • Are they impacted equally?
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Table 4: Summary of dimensions and issues explored in the research

Dimension	Factors identified in the international literature	Factors identified in the local literature	Issues or variables examined in the research
Geophysical/geographical	Flood-prone areas: <ul style="list-style-type: none"> • Proximity to rivers, floodplains etc. 	Flood-prone areas: <ul style="list-style-type: none"> • Low-lying areas • Proximity to waterbodies, wetlands and detention ponds • Proximity to drainage infrastructure • Proximity to roads and/or hard surfaces 	Topographic features: <ul style="list-style-type: none"> • Proximity to waterbodies, wetlands and detention ponds • Elevation above sea level • Position with respect to slopes Proximity to potential sources of run-off/overflow: <ul style="list-style-type: none"> • Proximity to paths, paved and unpaved roads • Proximity to drainage ditches, canals or drainage infrastructure • Proximity to slopes
Physical	<ul style="list-style-type: none"> • Poor-quality housing 	<ul style="list-style-type: none"> • Leaks in poorly built dwellings • Poor positioning of dwellings 	<ul style="list-style-type: none"> • Materials used to build dwellings • Dwelling characteristics • Presence of drainage infrastructure in subsidised housing areas • Build quality of dwellings • Space between dwellings

Socio-economic	<ul style="list-style-type: none"> • Poverty • Fragile incomes (low incomes, informal jobs, lack of savings) • Demographic factors 	<ul style="list-style-type: none"> • Poverty • Fragile incomes (low incomes, informal jobs, lack of savings) 	<ul style="list-style-type: none"> • Income levels • Employment types • Access to savings • Demographic profile of the household head • Length of time living in settlement
Protection and mitigation	<ul style="list-style-type: none"> • Lack of safety nets or social protection • Levels of assistance following hazard events • Levels of prevention • Knowledge of and implementation of mitigation measures 	<ul style="list-style-type: none"> • Levels of weatherproofing 	<ul style="list-style-type: none"> • Access to social protection (government grants) • Knowledge and adoption of protection measures to address or mitigate flooding • Access to assistance from disaster management following hazard events • Levels of personal or household insurance
Governance	<ul style="list-style-type: none"> • Institutional and/or regulatory framework • Regulation of development • Land use planning • Levels of prevention and response • Levels of service delivery 	<ul style="list-style-type: none"> • Poorly planned and managed urban growth • Service delivery • Weaknesses in the roll-out, monitoring and oversight of the subsidised housing programme • Limited capacity/ overburdening of local authorities 	<ul style="list-style-type: none"> • Levels of oversight and monitoring • Challenges faced by government in the roll-out of the subsidised housing programme • Roll-out and upkeep of drainage infrastructure

Overview of the research

As summarised in Table 5, the research was conducted in four phases, with each stage building on the research and analysis from the ones before:

- The first phase involved interviews with disaster risk management officials and other stakeholders (see Appendix 1). This preparatory research sought to identify the research areas, better understand government's subsidised housing programme, housing standards and other issues pertinent to the flooding question. It also sought to examine the macro-level factors influencing risk, such as the political factors influencing the rollout housing and challenges characterising the programme.
- The second phase involved the collection of qualitative data on each of the research sites, and included a focus group discussion in each site, interviews with community leaders and walks through each of the settlements.
- This information was primarily used to inform the design of the quantitative data collection tool, although it also helped to provide contextual information on the views and experiences of people in each area.
- The third phase involved a quantitative survey conducted amongst 500 randomly selected households, 50 in each site, with the questionnaire drawing on the information gathered in the second phase. Global positioning system (GPS) coordinates were recorded for each household surveyed, along with its elevation, and additional topographical data was collected for each site.
- The fourth phase focused on the analysis of the data. This included the descriptive analysis of the quantitative data, the statistical modelling of the survey data and mapping the spatial data against the other topographical information for the areas studied. The descriptive analysis examined the extent, nature and impact of

flooding on both subsidised and informal households, while the statistical and spatial analyses focused on the drivers of risk in subsidised housing areas.

Table 5: Summary of methodology

Phase	Components	Purpose	Methods
1.	Preparatory research	<ul style="list-style-type: none"> • Identification of research sites 	<ul style="list-style-type: none"> • Interviews with disaster management officials and other stakeholders
2.	Qualitative research	<ul style="list-style-type: none"> • To understand the histories, characteristics and issues facing settlements • To inform the development of the research questionnaire and sampling 	<ul style="list-style-type: none"> • Focus groups • Observation of fieldwork sites • Interviews with local councillors and other identified role-players
3.	Quantitative data collection	<ul style="list-style-type: none"> • Collection of data for statistical and spatial analyses 	<ul style="list-style-type: none"> • Modular quantitative household survey of 500 households • Plotting of sites using GPS; collection of spatial data on research sites
4.	Analysis and consolidation	<ul style="list-style-type: none"> • Analysis • Collection of flooding histories 	<ul style="list-style-type: none"> • Descriptive analysis of the extent and nature of flooding and its impact on households in formal and informal housing • Statistical regression modelling of survey data on risk factors in formal housing • Mapping of spatial data

The research was conducted between October 2010 and February 2011. The qualitative research was carried out between October 2010 and January 2011. The questionnaire was piloted in late December and revised in early January. It took approximately three months to negotiate access to the communities, as this required identifying and meeting with one or more community leaders in each area to explain the project, and obtain their permission to work in the settlement. It also took time to identify the formal housing sites. As discussed later in this chapter, identifying the informal sites was straightforward, but the DRMC and other stakeholders were unable to suggest potential formal communities. For this reason, the selection of the subsidised housing was linked to that of the informal settlements, with the former identified only after identifying and visiting the informal sites. It also took time to source the spatial data. It was necessary to approach several government departments.

In some cases the only available data was out of date or insufficiently detailed to be useful. For instance, an effort was made to obtain data on groundwater levels in the research areas, for instance, but after approaching several different governmental and private institutions it was evident that the extant was insufficiently detailed to support in-depth analysis.

The choice of methods

There were several reasons for choosing a combination of methods rather than a purely qualitative or quantitative approach. The first concerns an analytical gap in the literature. Virtually all of the data on flood-risk in poor South African communities is qualitative, with most gathered from interviews, focus group discussions or using participatory risk assessment techniques. There exists nominal quantitative data on flood-risk, one of the exceptions being the small-scale, single-site study by Ameen Benjamin (2008) (see Chapter 3). The qualitative data gathered in these studies is valuable but provides only a snapshot of what is happening in a small number of communities, as lived and understood by the people interviewed. I aimed to fill this gap by collecting comparable data from a larger number of settlements. Quantitative tools, such as surveys, allow for standardised data collection on a much larger scale, making it possible to compare the experiences of a broader sample of respondents (Mayoux, 2006; Mack et al, 2005). This allows for a more comprehensive picture of what is happening in each research site and enables comparison between areas. The collection of quantitative data also allows for statistical analysis that can help to identify trends and patterns, which was important for this thesis.

A combination of techniques helps to overcome the pitfalls associated with a single method. For example, surveys collect superficial information compared to the rich, layered data possible from qualitative research. The process is also researcher-led and a survey's success in capturing issues relies heavily on the knowledge of those designing the questionnaire (Mack et al, 2005). The combination of a quantitative and qualitative approach allows for comparison within and between sites, while also allowing for the collection of qualitative narratives (Mayoux, 2006; Mack et al, 2005;

Sogunro, 2002). In this study, the core purpose of the qualitative research was to identify types of flooding, possible risk-drivers and impacts, and which areas were most affected by flooding, which helped to inform both the sampling of the survey and the design of the questionnaire.

The collection of spatial data adds an additional perspective to the study. It allows for the analysis of geographical factors pertinent to flooding that are difficult to explore using social research methods. In this case, these included topographical variables such as elevation and proximity to slopes, wetlands and other waterbodies. Spatial analysis also introduces a visual component that allows for new insights and perspectives that may be harder to see using other analytical tools (Chrisman, 2002).

The combination of qualitative, quantitative and spatial tools thus enables the collection of multi-layered data that contributes to a more holistic analysis of flooding in subsidised and informal housing settlements. The three research methods provide different perspectives on flooding, while also complementing each other to provide a more comprehensive picture of the extent, nature and impact of flooding on the Cape Flats. Layering the different research collection tools also enables triangulation of the research findings to ensure a more accurate empirical picture of flood-risk.

The sections below examine how the research sites were identified and the approach adopted in both the qualitative and quantitative research. The first section discusses how the ten sites were selected. The second describes the purpose and components of the qualitative research. The third outlines the components of the quantitative research, how households were selected for interview, how flooding was conceptualised and studied, and the limitations of my approach used to collect the quantitative data and ethical considerations.

Site selection

I selected the informal using information provided by Cape Town's DRMC. The informal sites were selected from a list of the 20 most flood-prone settlements

generated each year in the run-up to the rainy season. I took into consideration several factors. In addition to the frequency of water-related problems, these included the accessibility of communities, particularly the willingness of local councillors and community leaders to participate, the extent of previous research in the areas, and proximity to potential formal sites. Areas that had already been researched extensively were not selected in order to avoid interview-fatigue on the part of respondents. Table 6 shows the geographical spread of the sites, with four in Philippi and one in Gugulethu, both of which lie on the Cape Flats.

The selection of the formal sites was linked to that of the informal sites. The preparatory research revealed a dearth of information on flooding in formal housing areas. Interviews with DRMC officials and others showed that the authorities focus on informal settlements, with no information available on potentially high-risk formal areas. Working on the assumption that neighbouring sites are likely to share at least some of the same physical vulnerabilities, such as topological features, I chose formal subsidised housing sites that were adjacent to or near each informal settlement. In Gugulethu, two corresponding informal sites were chosen as, although immediately adjacent to one another, they comprised two quite different housing models: an in-situ informal settlement upgrade and a contractor-built housing development. This provided an opportunity to examine differences between housing delivery models.

Settlements representing different housing models were chosen to assess the extent to which settlement type influences vulnerability. The sample included one contractor-built settlement developed under the UISP (Better Life), two contractor-built greenfield projects (Luyoloville and Samora Machel), one settlement developed under government's PHP (Vukuzenzele) and one mixed UISP and PHP settlement (New Rest). The study was not primarily concerned with comparing dwellings built under the various housing models, but the different housing types allude to potentially influential dynamics, such as differences in the design of dwellings and settlements, the quality of buildings and their location. Respondents in PHP settlements, for instance, could plausibly have greater input into how their houses and settlements were designed and the types and quality of the materials used, than those in contractor-built settlements.

Table 6: The research sites

Informal site	DRMC ranking	Linked formal site	Area
Kosovo	1	Samora Machel	Philippi
Sweet Home	2	Vukuzenzele	Philippi
Never-Never (Area K)	3	Better Life (Philippi Park)	Philippi
Kanana	5	New Rest	Gugulethu
		Luyoloville	
Phola Park Philippi	10	Better Life (Philippi Park)	Philippi

The qualitative research

For the qualitative component, I used a combination of interviews, direct observation and focus groups to gather information on flooding in each community. Community leaders for each of the settlements were identified with the assistance of the DRMC and other stakeholders (see Appendix 1). One mixed focus group, comprising six to 12 adult men and women from the community, was run in each site.¹⁸ Participants were selected with the assistance of community leaders, and were purposively sampled from across each site to ensure that the perspectives of people from different areas were represented. The groups were facilitated in English, with a translator on hand to interpret questions and discussions. The facilitator used a standardised discussion guide to ensure consistency in the range of themes examined in each site (Appendix 2).¹⁹ The sessions were recorded for reference purposes.

¹⁸ 12 people participated in the focus groups in Better Life, Luyoloville, Samora Machel and Vukuzenzele; and seven in New Rest. In the informal areas, the discussions included 12 respondents in Kanana and Kosovo; ten in Phola Park; nine in Never-Never; and eight in Sweet Home.

¹⁹ The discussion guide was English, with the discussions primarily in English. The translator assisted in translating questions where they were difficult to understand in English, or where participants preferred to discuss issues in their own language, almost exclusively Xhosa. The purpose and intent of the questions were discussed with the translator prior to the first group, with the interpretation of questions brainstormed to help ensure that translations captured the essence of the English questions.

The research explored the prevalence and nature of the hazard, how it manifests, as well as sources and responses to risk, and their impact. It examined the drivers of risk by identifying high- and low-risk areas and dwellings, and the specific bundle factors driving exposure. In the focus group sessions, participants were asked to identify on aerial photographs parts of the settlement or dwellings that often or seldom saw flooding; what it was about these that increased or decreased the experience of problems; and how affected households sought to mitigate risk. The key issues were further explored and illustrated through the guided walk through the settlement. Specifically, the qualitative research explored:

- the conditions in each area, including the nature and sources of flooding, the extent and state of pertinent infrastructure, and flood hot-spots;
- at-risk people's experience and interpretation of flooding;
- the factors that increase or reduce the likelihood of someone having their dwelling flooded; and
- people's efforts to mitigate or manage flood-risk.

The qualitative data was analysed thematically. Field and focus group notes were collated and themes identified and grouped manually. The information collected during phases one and two was analysed prior to the quantitative phase of the research, with the findings used to identify the key issues to include in the survey, as well as the coding of questions. The qualitative findings were again consulted during the analysis of the quantitative data, to assist in interpreting and enriching the quantitative findings.

Quantitative data collection

The quantitative component involved a household survey. Drawing on the findings of the qualitative research, the survey aimed to capture the prevalence of different types of flooding in different settlements, its impact and households' efforts to mitigate risk.

facilitated the focus groups and was on-hand to discuss the understanding and interpretation of questions.

The survey instrument also sought to gather data on risk drivers, such as the type of dwelling and proximity to waterbodies, hard surfaces, and to test assumptions about who is vulnerable. In order to explore whether it is poorer households or other 'vulnerable' groups that are most at risk, for instance, the survey collected information on households' socio-economic characteristics, such as the available financial resources and the age and gender of the household head.

The calculation of the sample size was informed by data on the prevalence of rain-related concerns in each settlement collected during the qualitative phase. The formula $n = [Z^2 p (1-P)/SE^2] \times D$, produced an initial sample size of 491, which was rounded to 500. N here refers to the size of the sample. Z refers to the desired confidence level, in this case 95%. The confidence level refers to the statistical confidence that the findings accurately reflect the situation in the population studied. P refers to the occurrence of a particular trait in the population studied, in this case the proportion of people experiencing flooding in the research areas. The P value for the study was estimated from average levels of flooding reported during the focus group discussions. SE refers to the standard error or desired level of precision for the particular variables examined, and again concerns the expected reliability of the findings. D refers to the design effect, and reflects levels of variance in the sample. Filling in these values, the sample was calculated as follows: $n = [1.96^2 \cdot .70 (1-.70)/0.5^2] \times 2$.

Within sites, I adopted a cluster sampling procedure. A total of 50 households were sampled in each of the ten sites, stratified equally by perceived risk. Using aerial photographs, each settlement was divided into roughly equally sized segments. With the exception of Better Life, Luyoloville and New Rest, where the qualitative research suggested uniform levels of risk, some segments included higher-risk areas identified during the qualitative phase and others lower-risk areas. Each segment was numbered and, depending on the size of the settlement, between two and four 'high-risk' and 'low-risk' segments were chosen for study using a random numbers table. Within each chosen segment, fieldworkers visited every *n*th household, depending on the size of the settlement. The clustered sampling approach aimed to ensure that all groups of interest were included in the study, while interval sampling within clusters ensured that households in a particular area had an equal chance of being selected for

interview. This helps to reduce the risk of sample bias, which often becomes problematic when respondents are chosen purposively.²⁰

A team of four fieldworkers administered the survey questionnaires. The questionnaires were in English. Given the size of the sample and the fact that most of those interviewed did not speak English as their first language, I used a team of fieldworkers able to speak the prevailing languages in each site – primarily isiXhosa, with some Afrikaans. All four fieldworkers had prior experience conducting social research surveys. It can be uncomfortable for respondents to answer personal questions, such as a household's income level, if the interviewer is known or from the same area. To avoid this, and ensure the confidentiality of the information gathered from each respondent, all four enumerators were chosen from outside the survey sites. I was in field with the teams and was on hand to help with sampling, to discuss issues arising and to meet with respondents who wanted to know more about the study.

The questionnaire was administered in face-to-face interviews. The fieldworkers interviewed an adult in each household, preferably the household head. The questionnaire was English but was administered by fieldworkers able and trained to translate questions into other languages as required.²¹ Each interview took between 25 and 45 minutes to complete depending on households' experiences. All interviews were confidential; no names were recorded and interviewers were instructed to ensure that they were conducted entirely in private.

The survey questionnaire comprised two components: a visual component completed by the fieldworker and questions answered by the respondent. The fieldworker completed the visual survey prior to the interview with selected respondents. The visual survey included questions on the readily apparent features of the dwelling.

²⁰ A purposive sample is a non-representative subset of some larger population, and is constructed to serve a specific need or purpose, with participants selected on the basis of a shared characteristic, such as specialist knowledge, capacity or willingness to participate in the research. Because people are chosen for specific expertise or ease of inclusion, the results are likely to reflect a narrower range of experience than if the sample is selected randomly (Oliver, 2006).

²¹ As with the qualitative research, the purpose and intent of the questions were discussed extensively with the fieldworkers, with the interpretation of questions brainstormed to help ensure that translations captured the essence of the English questions. Fieldworkers were also provided with visual aids, such as pictures of different building materials, waterproofing and guttering, as well as a diagramme of a cavity wall to help convey the meaning of questions.

Splitting the questionnaire helped to reduce the length of the face-to-face interview, ensuring as brief a disruption to the respondent's daily activities as possible. The questions included:

- the materials used in the dwelling's construction;
- the type and aspect of the roof and the extent to which it overhung the exterior walls;
- the height of the floor relative to surrounding ground;
- the presence of drainage infrastructure;
- whether the dwelling had a ceiling;
- the distance between houses; and
- the proximity of the dwelling to features that might serve as conduits for rainwater, such as canals or drainage ditches, drains and roads (see Appendix 3 for a summary of the questionnaire).

The remainder of the questionnaire comprised modules that collected information on the characteristics of the household; the household's average monthly income and expenditure; the experience of rain-related problems and their impact; and whether the household attempted to reduce the risk of experiencing problems and the nature and effectiveness of the measures. Those living in formal dwellings were asked additional questions. These collected information on when and by whom the dwelling was built, as well as less visible features of the dwelling, such as cavity walls and ventilation panels.

The questionnaire explored several different kinds of flooding. As discussed in Chapters 2 and 3, 'flooding' comprises a range of different event-types, particularly in urban areas where poor households often experience flooding that spans conventional flood-types, such as coastal and riverine flooding, and kinds of flooding rooted in under-development, poor planning and building standards. Drawing especially on Benjamin's (2008) flood typology for the Western Cape and the information gathered during the qualitative research, respondents were asked about seven different types of problems, with the option of identifying other unlisted issues. These comprised:

- water running into the dwelling from roads, streets or slopes;
- water running into the dwelling from overflowing drainage canals or ditches;
- water running into the dwelling from water pooling in the yard or around the dwelling;
- water or damp coming up through the floor;
- leaking roofs;
- leaking walls;
- leaking through or around doors and window-frames.

These seven types of flooding represent a continuum of experience; while all can result in houses being inundated with water, some, particularly leaks, may not result in ‘flooding’ per se, but as discussed in Chapter 6, have the potential to seriously damage dwellings and property and impact negatively on households’ quality of life.

Limitations of the survey

The approach to the quantitative data collection has limitations (Table 7). These include recall and reporting issues, as well as reliance on respondents’ knowledge of the area. As with any self-reporting approach, there was a danger that respondents would intentionally or unintentionally under- or over-report their experience of flood incidents, either because they hoped to receive assistance or because they recalled events inaccurately. The population in informal areas is often fluid, with people moving in and out of settlements on a regular basis. This presented an additional challenge, as new arrivals may not have lived in settlements long enough to have experienced flooding, or to provide comprehensive flood histories. These constraints could not be eliminated entirely, but the research incorporated several measures aimed at minimising their impact on the data. These are presented in the table below.

Table 7: The limitations of survey and amelioration measures adopted

Limitation	Mitigating measures
Recall issues	<ul style="list-style-type: none"> • Flood histories were collected using a grid format in which respondents are asked to recall events over the last three years before cascading into questions about their experiences in the year before the survey

	<ul style="list-style-type: none"> • The recall period was limited to the three years prior to the survey • Respondents were only asked to speak in depth about what they considered the most serious event
Over-reporting	<ul style="list-style-type: none"> • The aims of the research were carefully and thoroughly explained to both community leaders and study participants • Fieldworkers were trained to look out for and probe significant outliers to assess the accuracy of the information provided
Knowledge deficits	<ul style="list-style-type: none"> • Households were screened prior to the interview; only respondents in households that moved into the community before the 1st of May 2009 were interviewed • Where formal plots included a front- or backyard shack, fieldworkers were to identify and interview only someone who was or had been living in the formal dwelling

Analysis and consolidation of the quantitative data

This section describes how the quantitative data was collected, processed and analysed. It discusses the modelling of the data, including how the binary logistic regression models were constructed, the indicators included and the rationale for selecting variables.

The data was captured and analysed using the Statistical Package for the Social Sciences (SPSS). This programme is used in social research and supports advanced statistical modelling. The data was modelled using binary logistic regression analysis. This is widely used to explore the relationships between a set of potentially explanatory variables and a particular dependent variable or outcome. More specifically, regression analysis helps to understand how an outcome - in this case the likelihood of a person's dwelling being flooded - changes when explanatory variables are added or removed from a statistical model. This indicates which factors are more or less important in predicting risk. The aim of the modelling was to identify which environmental, physical and social factors increase or decrease flood-risk, as well as their relative importance.

The model building process

The regression analysis used Forward and Backwards Stepwise Likelihood Ratio (LR) methods. The resulting models were then assessed for outliers and residuals to assess their accuracy. The process involved three steps:

- **Step 1: Analysis of multicollinearity.** Multicollinearity exists where there are strong correlations between two or more predictor variables. It makes it difficult to assess statistically which variable is actually producing a given effect (Field, 2005). This initial step used correlation analysis to identify and address multicollinearity between variables.
- **Step 2: Backwards and forwards LR stepwise regression.** The selected variables were run against the data on households' experience of different kinds of flooding. In the Forwards method, the computer programme adds variables to a baseline, constant-only model by testing which factors significantly improve the predictive capacity of the model. The Backwards method does the opposite, using slightly different statistical tests. The programme starts with all the test variables in the model, and progressively removes those that do not influence the model's predictive capacity. The models produced by the Forwards and Backwards procedures were compared and the strongest selected for interpretation. These were in all cases models produced through the Backwards Stepwise procedure. The models were run using both Backwards and Forwards methods in order to assess their stability. A similar outcome in both the Forwards and Backwards models shows internal consistency (Mauff, personal communication, August, 2011).

Stepwise methods have been criticised for relying solely on mathematical criteria to build models. Some argue that this takes important methodological decisions out of the hands of the researcher and that the outcomes may be influenced by random sampling variation (Field, 2005). Stepwise methods are, however, very useful in exploratory research where large numbers of variables make the model-building process computationally intensive and demanding (Mauff, personal

communication, August, 2011). The Stepwise method was adopted for this strength.

- **Step 3: Diagnostic analysis of the models.** The final models were assessed for outliers and overly influential cases to ensure they fitted the data well and were not biased by a few cases. This involved obtaining and analysing residual and influence statistics for all the cases represented in the model. Major outliers and unduly influential cases were assessed for errors and/or reasons for their differentiation. These were in some cases removed to improve the accuracy of the model, but only in extreme cases.²²

The choice of indicators

Working on the assumption that specific types of flooding are likely to be associated with particular drivers, the models included only those variables relevant to each kind of flooding. The seven flood-types examined in the questionnaire were grouped into clusters of variables likely to be rooted in similar issues. These comprised:

- **Run-off:** including water running into the dwelling from roads, streets or slopes; water running into the dwelling from drainage ditches or canals; and water pooling in the yard or around the dwelling.
- **Seepage:** water or damp coming up through the dwelling's floor.
- **Structural issues:** including water entering the dwelling through leaks in the roof or walls, or from around the doors and window-frames.

The analysis examined these flood-types against four broad clusters of factors. These comprised geographical characteristics, the physical-architectural characteristics of

²² Outliers were identified on the basis of their Standardised Residual values, while influential cases were identified using their Predicted Values, Cook's Distance statistics, Leverage values and their DFBeta values. Following Field's suggestion, Standardised Residual values close to and over 3 were examined, as were Cook's Distance values over 1. Appropriate leverage values were calculated using the formula $(k+1)/N$, where k was the number of predictors and N the sample size (Field, 2005).

the dwelling, the socio-economic characteristics of the household and other features, such as the amount of time taken to build the dwelling, and whether the household adopted measures to mitigate rain-related problems. My choice of indicators was informed by the disaster risk literature reviewed in Chapter 2, the housing literature described in Chapter 3, and the qualitative research.

Location variables

As discussed in Chapters 2 and 3, discussions on flooding often emphasise the geographical components of risk, such as proximity to rivers or other watercourses that overflow during heavy rains. The emerging literature on urban flooding adds factors such as urban sprawl into wetlands, inadequacies in drainage infrastructure, and poorly built and weatherproofed dwellings. Research on flooding in Cape Town identifies additional context-specific factors, particularly the high water table on the Cape Flats, with seepage common in low-lying areas.

I included several topographical factors aimed at assessing the impact of geographical factors on flood-risk. These included the elevation of the dwelling, as captured by GPS and, in the case of run-off, its proximity to a noticeable slope. Information on dwellings' proximity to hard surfaces such as roads and tracks, as well as drainage ditches and canals were captured but not included in the models. This was largely due to the uniformity of the formal sample: virtually all of the dwellings were within metres of a road, and only a handful were sufficiently close to drainage infrastructure for this to represent a major contributory factor for flooding.

Dwelling characteristics

I also included a range of variables aimed at assessing the role of the built environment in driving vulnerability. These drew on the qualitative research, official and unofficial building codes and the local literature on flooding. They centred on the physical and architectural characteristics of dwellings, including the materials used for the walls, floor and roof, the height of the floor-slab relative to street or ground-level, the space between houses, and the pitch of the roof. Data on the presence of formal drainage infrastructure was captured but not included as very few dwellings

had either guttering or any kind of drainage infrastructure on the plot. Only houses in Luyoloville had guttering. However, this guttering emptied onto a concrete apron surrounding the dwelling and not into a drain, suggesting that the gutters were likely to increase rather than decrease the likelihood of problems (see Chapter 7).

I drew on the National Housing Code and local best practice in designing and choosing variables. Wherever possible, I used parameters adopted in the National Housing Code or suggested in either the literature or the qualitative research. It was necessary to use a range of sources as the Housing Code often lacks detail. For example, it specifies that walls must be damp-proofed but it does not specify how this is to be achieved. The qualitative research and guidelines published by organisations such as the Federation for the Urban Poor (FEDUP) provided useful parameters. As discussed in Chapter 7, FEDUP's guidelines state that:

- walls should be plastered;
- roofs should be asbestos-free and should overhang the exterior wall by at least 60 cm;
- the floor slab should be at least 15-20 cm above the lowest curb on the property; and
- roofs should be sloped.

The models included questions on whether dwellings had ceilings and cavity walls.²³ As discussed further in Chapter 5, Cape Town lies in the Southern Coastal Condensation Problem Area (SCCPA). Because of its location, the Housing Code specifies that dwellings should have ceilings. It does not require cavity walls, but Agrément South Africa and sources consulted during the fieldwork highlighted the value of cavity walls in preventing damp in the SCCPA (see Chapter 5). The qualitative research also suggested additional issues. In Samora Machel, for example, focus group participants suggested that dwellings built using concrete panels (vibracrete) were more prone to problems than those using concrete blocks. Similarly, the focus group in Vukuzenzele indicated that the space between dwellings was important, with respondents reporting that where dwellings were close together, water

²³ Cavity walls consist of a double-skinned wall with a gap, or cavity, in the middle designed to prevent water rising into the wall from the ground or penetrating from the exterior wall (Appendix 4).

flows off dwellings' roofs into neighbouring properties, either pooling around the house or pouring against the external wall.

The indicators were largely confined to visible characteristics. Official and unofficial guidelines include a range of less visible provisions, such the need for foundations to be laid over damp-proof membranes, the thickness of walls and the thickness of plastering, but it is unlikely that respondents other than those in PHP housing would know whether these guidelines were followed. The survey focused on characteristics that could be identified easily by either the fieldworker or respondent. The exception was cavity walls; given the key role that cavity walls could play in reducing the likelihood of problems, respondents were asked whether their dwelling had double walling.

Other physical characteristics

In an effort to assess the quality of buildings, I included a variable on housing type and the average time taken to build the dwelling. It is possible that dwellings built by, or under the supervision of, beneficiaries will be of a higher quality than mass-produced housing built by contractors. In this vein, the models included a question on whether dwellings were built by the owner or a contractor. Turning to build-time, respondents were asked how many days or months it had taken to build the dwelling. The reported time periods varied widely, even in contractor-built developments where the construction process was highly standardised. In an effort overcome misreporting, the build-times were averaged for each site, with households allocated an average build-time for their particular settlement.

Measures to mitigate flooding or water-related damage

I also included variables aimed at capturing whether households had implemented measures to address flooding. Given that households often experienced more than one type of flooding, and that some mitigation measures might address some kinds of flooding more than others, responses were stratified according to their relevance to each flood-type. Measures included:

- **Run-off:** raising the level of the floor, digging channels to direct water away from the dwelling, building barriers to prevent water flowing into the dwelling and raising the ground around the dwelling by laying sand or concrete.
- **Seepage:** raising the level of the floor, laying a concrete floor-slab or adding to the existing slab.
- **Structural problems:** rebuilding walls using different materials, and plastering or re-plastering walls, putting plastic or tar on roofs to prevent leaks, putting in cavity walls, putting in a ceiling or other interventions.

Socio-economic characteristics

With the socio-economic variables, I sought to test the extent to which risk is socially constructed. As discussed in Chapter 2, the political ecology approach emphasises the role of socio-economic characteristics and other factors, such as access to resources and socio-political participation, in driving vulnerability and risk. The models included several variables aimed at capturing households' socio-economic status. These included indicators on household income and the age and gender of the household head. Households' economic status was represented by their income per capita. This was calculated by subtracting the monthly expenses reported by each household from their reported monthly income and dividing this figure by the number of people living permanently in the household. The variables on the age and gender of the household do not measure socio-economic status as directly as income per capita, but they are often used as markers for social status. Discussions in the development sector, for instance, often identify households headed by women or the elderly as more economically and socially fragile than those headed by men (for instance, Fierlback, 1997; Elson, 1991; Kabeer, 1989).

It is frequently difficult to obtain reliable data on income and expenditure through household surveys. Respondents frequently over- or underestimate income and spending, either accidentally or deliberately. Calculating income and expenditure with precision requires dedicated surveys that capture in great depth both monetary and in-

kind resource flows. Such a detailed approach was beyond the scope of this research, but I sought to increase the reliability of the data by leading respondents through a series of questions aimed at capturing monthly income and expenditure. Respondents were asked how much money came into their household each month from employment, businesses, pensions and social grants provided by government. The answers were summed to provide a total amount. They were also asked how much they spent on monthly expenses such as food, utility bills, transport and school fees, with these again summed to provide a total amount.

Table 8: Summary of indicators used in the statistical analysis

Problem-type	Formal dwellings
Run-off	Location variables: <ul style="list-style-type: none"> • Elevation • Proximity to significant slopes Dwelling characteristics: <ul style="list-style-type: none"> • The space between dwelling and neighbouring houses • Height of the floor above ground or street level • Mitigation measures Socio-economic characteristics: <ul style="list-style-type: none"> • Age and gender of the household head • Disposable income per capita Other: <ul style="list-style-type: none"> • Contractor-built or PHP
Seepage	Location variables: <ul style="list-style-type: none"> • Elevation Dwelling characteristics: <ul style="list-style-type: none"> • Material used for the floor • Average time taken to build dwelling • Mitigation measures Socio-economic characteristics: <ul style="list-style-type: none"> • Age and gender of the household head • Disposable income per capita Other: <ul style="list-style-type: none"> • Contractor-built or PHP
Structure-related	Dwelling characteristics:

	<ul style="list-style-type: none"> • Material used for the roof and walls • Roof-type • By how much roof overhangs walls • Presence of a ceiling • Average time taken to build house • Mitigation measures <p>Socio-economic characteristics:</p> <ul style="list-style-type: none"> • Age and gender of the household head • Disposable income per capita
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The spatial data collection

This section discusses the approach used to collect and analyse the spatial data used in the study. It examines the types of information collected, the data sources and the rationale behind the choice of the data used.

The spatial analysis was designed to augment the statistical analysis. It sought to explore whether there is a geospatial component to the hazard and risk-drivers. As noted in chapter 2, and earlier in this chapter, flooding is assumed to have a strong geographical component. Exposure is often considered greatest alongside rivers or other watercourses, for instance, or where surfaces and slopes facilitate run-off. In this context, the spatial analysis examined the role of topographic features such as households' proximity to waterbodies, significant surface-level drainage features slopes in driving flooding. The data collection comprised two components. First, the coordinates of each dwelling were obtained using handheld GPS. This information was recorded on the survey questionnaire and captured into the SPSS data set. This was then georeferenced in ArcGIS to allow for spatial analysis. Second, detailed information was collected on the elevations in each site as a whole, their proximity to wetlands and other perennial and non-perennial waterbodies, including detention ponds, and drainage features such as canals and open drains.

The topographical data was obtained from several sources. The information on wetlands and waterbodies was obtained from the Catchment, Stormwater and River

Management Department at the Directorate for Roads and Stormwater in the City of Cape Town. The data on wetlands was compiled in 2010, and included permanent waterbodies, intermittent waterbodies that appear in depressions during rainy periods, rivers and detention ponds. The elevation data and information on drainage infrastructure was obtained primarily from the City's Strategic Development Information (SDI) and Geographic Information System (GIS) Department, and represents the most recent data available. Some key features in the study areas did not appear in the datasets provided by the various government departments. In these cases, the features were digitised from the aerial photographs and topographic maps of Philippi and Gugulethu. These were obtained from the Department of Environmental Affairs.

An effort was made to obtain data on the underlying hydrology in the survey sites, but it was impossible to trace detailed hydrological data. Data on groundwater levels for the City of Cape Town were obtained from both the City's GIS department and from the Department of Environmental Affairs, but in both cases the data was based on sampled boreholes in a limited number of surveillance sites, none of which were near to any of the research areas. This data was interpolated using ArcGIS, but the results were too broad and coarse to support meaningful analysis.

Summary of analytical components

In summary, the analytical scope of the study ratcheted down from a comparison between all ten sites to a specific focus on the drivers of vulnerability in the five formal housing areas (Table 9). The qualitative data and some of the information collected during the survey were used to explore the extent, nature and impact of flooding in both informal and subsidised housing settlements, and were used to test prevailing assumptions about flood-risk in subsidised and informal housing areas. The second analytical component, the statistical analysis, focused specifically on the factors making households vulnerable to flooding in subsidised housing, with an emphasis on the physical features of the built environment and socio-economic factors. The third component, the spatial analysis, complemented the statistical modelling by exploring geographical factors difficult to explore in a survey.

Specifically, this component examined the role of physical and topographical factors in determining why some households experience flooding while others do not.

Table 9: Summary of analytical approach

Analysis	Source	Focus
Descriptive analysis	<ul style="list-style-type: none"> • Qualitative data • Survey data 	<ul style="list-style-type: none"> • The extent, nature and impact of flooding in both informal and subsidised housing settlements • Macro-level drivers of risk
Statistical analysis	<ul style="list-style-type: none"> • Survey data 	<ul style="list-style-type: none"> • The drivers of vulnerability in subsidised housing specifically • The role of the built environment and socio-economic factors in driving vulnerability
Spatial analysis	<ul style="list-style-type: none"> • GIS data collected from government departments • GPS coordinates collected for each household surveyed 	<ul style="list-style-type: none"> • The role of geographical factors in driving vulnerability in subsidised housing settlements

The combination of methods enabled a layered, multidimensional analysis of flood-risk and allowed for a degree of triangulation between tools. In the context of the tenets of the political ecology, however, a weakness in the methodology was its sensitivity to the macro-level dynamics that structure risk at the broadest scale. The qualitative research enabled some exploration of these issues, such as the factors underlying the poor quality of housing, for instance, but the research generally captured more immediate and proximate dynamics. Much of this deeper analysis is inferred from the literature discussed in Chapter 3 and 5 regarding the geographical, social and socio-economic marginality of the Cape Flats. Although these issues were not explored in depth in the research, this thesis recognises that Apartheid planning, entrenched patterns of ‘peripheralisation’, and very high levels of poverty and exclusion on the Cape Flats help to shape flood-risk at the macro-level. However, within this generalised environment, it focuses on whether risk is experienced evenly by people living on the Flats, and tests assumptions about the hazard, who is vulnerable and what makes them so.

Ethical considerations

The research sought to address two ethical considerations: confidentiality and minimising any inconvenience to the respondent. Given the sensitivity of some questions, particularly those regarding income and expenditure, the interviews were kept strictly confidential, with fieldworkers asked to ensure that discussions were kept private. All interviewers were from outside the research areas, and were unknown to the community. An effort was also made to minimise any disruption to respondents' time and activities, with the questionnaire divided into two sections, only one of which needed input from the interviewee.

Limitations of the research

In addition to the limitations discussed already, rainfall patterns posed a challenge to obtaining representative data. The winter of 2010 was drier than normal, with little flooding reported. In an effort to prevent this from influencing the results, the questionnaire asked respondents about their experiences over the three years preceding the study – the winters of 2007, 2008 and 2009 – as well as their experiences in 2010. The analysis was ultimately based on incidents during the preceding three years, as these findings are likely to be more representative of usual patterns of risk. This approach should have reduced any biases in the data resulting from the drier winter in 2010.

The results may be more open to bias in New Rest, which is newer than the other settlements. While building began in 2007, phased development means that some homes were built in 2010 and would not have been tested by higher rainfall conditions. In an effort to overcome this, fieldworkers were trained to screen respondents to determine when the dwelling was built, and only to interview people who had lived in the dwelling during the winter of 2010.

Testing assumptions about flooding in subsidised housing: Summarising the research approach and methods

This thesis tests the assumption that subsidised housing addresses flood-risk. The research approach and methods sought to capture iteratively people's experiences of flooding in both formal subsidised housing and informal settlements. The aim was to better understand flood-risk in the local context and the implications for theory and practice more broadly. The research was conducted in ten sites on the Cape Flats between November 2010 and February 2011, and combined qualitative, quantitative and spatial data collection methods. In an effort to examine how subsidised and informal settlements compare when it comes to flooding, data was collected on five formal and five informal settlements. Working on the assumption that settlements close to one another are likely to face similar geographical issues, such as proximity to waterbodies or elevation, each formal site was paired with an informal site adjacent to it or close by.

The combination of qualitative, quantitative and spatial research tools allowed for the collection of complementary, multi-layered data that captures holistically the experiences of people living in subsidised housing and informal settlements. This approach utilised the strengths of qualitative, quantitative and spatial data collection tools, while simultaneously addressing the weaknesses in each approach. The collection of qualitative, quantitative and spatial data allowed comparison between sites and the identification of patterns and trends, while also providing textured information on both people's experiences and the drivers of risk. By collecting information in both subsidised housing and informal settlements, the methodology also allowed for comparison between subsidised and informal settlements, with a view to better understanding if and how households' experience of flooding differs between settlement types.

The analysis cascaded down from a comparison between all ten sites to a specific focus on the drivers of vulnerability in the five subsidised housing areas. The qualitative data and some of the information collected during the survey were used to explore the extent, nature and impact of flooding in both informal and subsidised housing settlements. A second component focused on the drivers of risk in subsidised housing areas, including the role of building characteristics and features of the built environment, socio-economic factors and measures of participation in explaining risk.

The third, spatial component explored the role of topographical factors in determining why some households experience flooding while others do not.

The next chapter describes the Cape Flats, the research sites and the households included in the study. It aims to contextualise the analytical chapters that follow. The chapter explores the geographical and socio-economic context of the Flats, and the histories and features of the ten research sites. It also examines the socio-economic characteristics of the households included in the survey, and the physical attributes of the included dwellings.

University of Cape Town

CHAPTER 5

Sandy, Windy, Wet and Excluded: Contextualising the Research Sites

Introduction

Cape Town is a city of contrasts. Wealthy, lush suburbs nestle around the mountains surrounding the city bowl and extend to the north and south, while the majority of the city's poorer residents live on the Cape Flats. The Flats comprise a flat, sandy, low-lying plain on the southeastern outskirts of the city (Ziervogel and Smit, 2009). They are hot and windy in summer and are cold and prone to flooding during winter. As noted earlier, this development pattern is rooted in Apartheid planning, controlling tightly non-whites access to urban areas. As discussed in Chapter 3, the South African government has committed itself to addressing this legacy, but settlement trends continue to reflect and reproduce these inequalities through the continued "peripheralisation" of informal and subsidised housing settlements in the post-Apartheid era (Huchzermeyer, 2003:119).

The research sites lie in the suburbs of Philippi and Gugulethu on the Cape Flats. Although they are located only 20 to 30 kms from the City Bowl, they occupy an entirely different space socio-economically. The areas show high levels of poverty and unemployment, and most residents live in either informal settlements or subsidised housing. While population densities in most cities decline with distance from the centre, Cape Town, like other South African cities, shows an inverted density profile that rises with distance from the centre (Turok, 2011), with the bulk of the population on the Cape Flats. Residential densities in Cape Town range from as low as two to four units per hectare in the City's wealthiest suburbs and 90 to 100 units per hectare in inner city areas, but population densities rise to between 350 and 450 people per hectare in informal settlement areas (Wilkinson, 2000). Although city

planners have attempted to develop industrial corridors in Philippi (Adlard, 2008), both Gugulethu and Philippi are distant from the city's commercial and industrial centres, and there are limited economic opportunities.

This chapter explores the geographical and socio-economic characteristics of the Cape Flats, Gugulethu and Philippi and the research sites. It aims to contextualise the analytical chapters that follow by situating the sites and the households surveyed geographically and socially. The chapter explores the socio-economic and political histories that have helped to shape the study areas, as well as the topographical characteristics of Philippi and Gugulethu. It also examines the histories and geographical features of the individual sites, and the attributes of the dwellings and households included in the study.

The chapter ratchets down from examining the Cape Flats as a whole, to the situation in Philippi and Gugulethu, then to each site and, finally, to the households within them. The chapter begins by briefly sketching the history of political and social exclusion that has driven development on the Cape Flats. It then examines the geographical features of Philippi and Gugulethu and provides a brief overview of the two areas. The chapter next examines the histories of the individual sites. Lastly, it draws on the survey data to describe the socio-economic characteristics of the households included in the study and the features of the dwellings in which they live.

The social and physical division of space: A brief history of the Cape Flats

The Cape Flats cover an often imprecisely delineated area of approximately 765 km² (Maclear, 1995) across the Cape Peninsula (see Figure 9, page 119). The area consists of a low plain of deep marine sand deposits, the remnants of sand dunes, and is criss-crossed by several rivers (Wilkinson, 2000). There are also large numbers of annual and perennial wetlands and other waterbodies, as well as detention ponds. Detention ponds are flood-control mechanisms. They are dry in the summer, but are designed to drain water away from settlements and areas prone to flooding and fill with water during the winter.

The Cape Flats is a poor area. It is characterised by large numbers of informal settlements and a growing number of low-income housing settlements. It was estimated in 2005 that there were more than 100 informal settlements on the Cape Flats (Rodrigues et al, 2006), while the City of Cape Town's Five-Year Integrated Housing Plan for 2009/10 - 2013/14 reported, for instance, that there were approximately 14 subsidised housing projects under construction on the Flats in 2009 (City of Cape Town, 2009).

Prior to the 1940s, the Cape Flats were primarily rural, and comprised of farms, quarries and smallholdings, but from the 1940s onwards the Flats urbanised rapidly, in large part due to the Apartheid government's division of space along racial lines. Under Apartheid, segregation prevented non-whites from living freely in urban areas. The Group Areas Act of 1950 and the Reservation of Separate Amenities Act in 1953 rigidly restricted where people of colour were permitted to live. Thousands of people were forced from central locations such as District Six in the City Bowl to 'townships', most of which were on the Cape Flats (Turok, 2011; Wilkinson, 2011). Strict controls also prevented black migrants to the cities from living close to employment centres, and buffer zones of unused land were created between racial communities to reinforce segregation (Turok, 2011). Those with legal permission to live in the city were moved to suburbs including Gugulethu and Nyanga, Mitchell's Plain, Blue Downs and Delft, while those without permission occupied informal settlements. The townships had only rudimentary rental housing, infrastructure and facilities (Turok, 2001), and quickly became overcrowded, resulting in increasing numbers of informal settlements (Turok, 2001; Wilkinson, 2000).

Despite the post-Apartheid government's policy commitment to addressing the marginalisation of the Cape Flats, inequalities persist. In the City's recently published Spatial Development Framework (SDF), the authorities identify the need to integrate communities on the Cape Flats and other poor areas with Cape Town's wealthier areas, but acknowledge that "the inequitable and inefficient city form of the former Apartheid regime is still entrenched in Cape Town", arguing that developments in the southeast have "largely focused on the upgrade and de-densification of informal settlements. Lower-income and subsidised-housing developments have been similarly

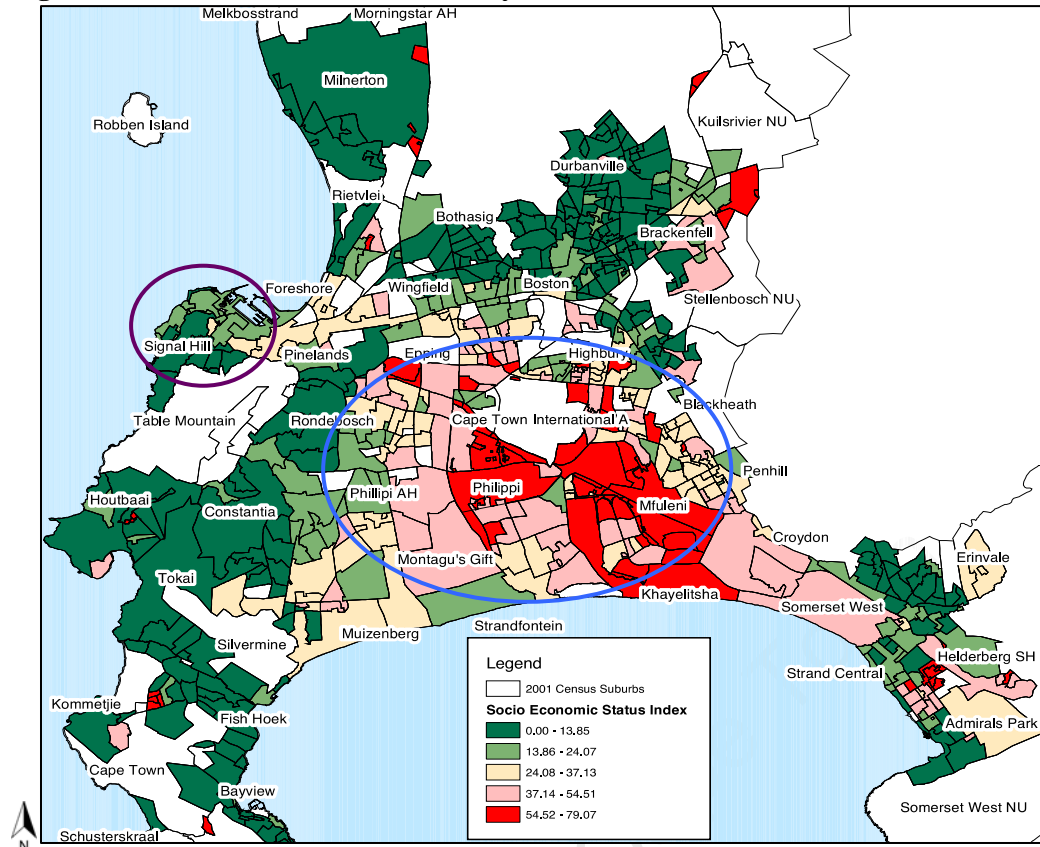
monofunctional, and generally do not display the qualities of an integrated human settlement” (CitySpace, 2012: 20).

The inequalities in Cape Town are illustrated by the available census data. In 2006, the City of Cape Town’s Information & Knowledge Management Department used the most recent census data (collected in 2001) to assess spatially differences in socio-economic status across the city (Romanovsky and Gie, 2006). The Department used data on the proportion of people earning less than what they calculated to be a minimum subsistence amount of R 19 200 per year, the proportion of adults with less than South Africa’s school-leaving education level, the economically active population unemployed, and the percentage of the labour force in elementary or unskilled occupations to create a Socio-Economic Status (SES) index.²⁴ Figure 9 shows the results, with higher scores indicating poorer socio-economic status and lower scores in better-off areas (with dark green representing the lowest). It shows that there is enormous variation between suburbs. The shades of green illustrate the relative wealth of those living in the City Bowl (marked by the purple circle) and Cape Town’s northern and southern suburbs, which achieve scores between 0 and 25 and the red and pink areas the greater poverty on the Cape Flats (marked by the blue circle). The red areas show the suburbs with the highest scores, pointing to the high levels of socio-economic poverty in areas such as Philippi, Khayelitsha and Mfuleni, which show scores between 54 and 79.

As discussed in the next section, Philippi and Gugulethu share the geographical and socio-economic features of the Cape Flats. The section examines the topographical features of Philippi and Gugulethu and, in particular, the factors that have shaped housing developments in these areas.

²⁴ The figure of R 19 200 per annum approximates the household subsistence level for Cape Town for 2001 as calculated by the Institute for Planning Research at the University of Port Elizabeth. The education indicator refers to the number of people with less than a matric qualification, the equivalent of grade 12, which is regarded as the minimum level required for post-school training. The employment indicator is calculated on the number of adults over the age of 19 who were unemployed but actively seeking work.

Figure 9: Socio-economic status by suburb (2001)

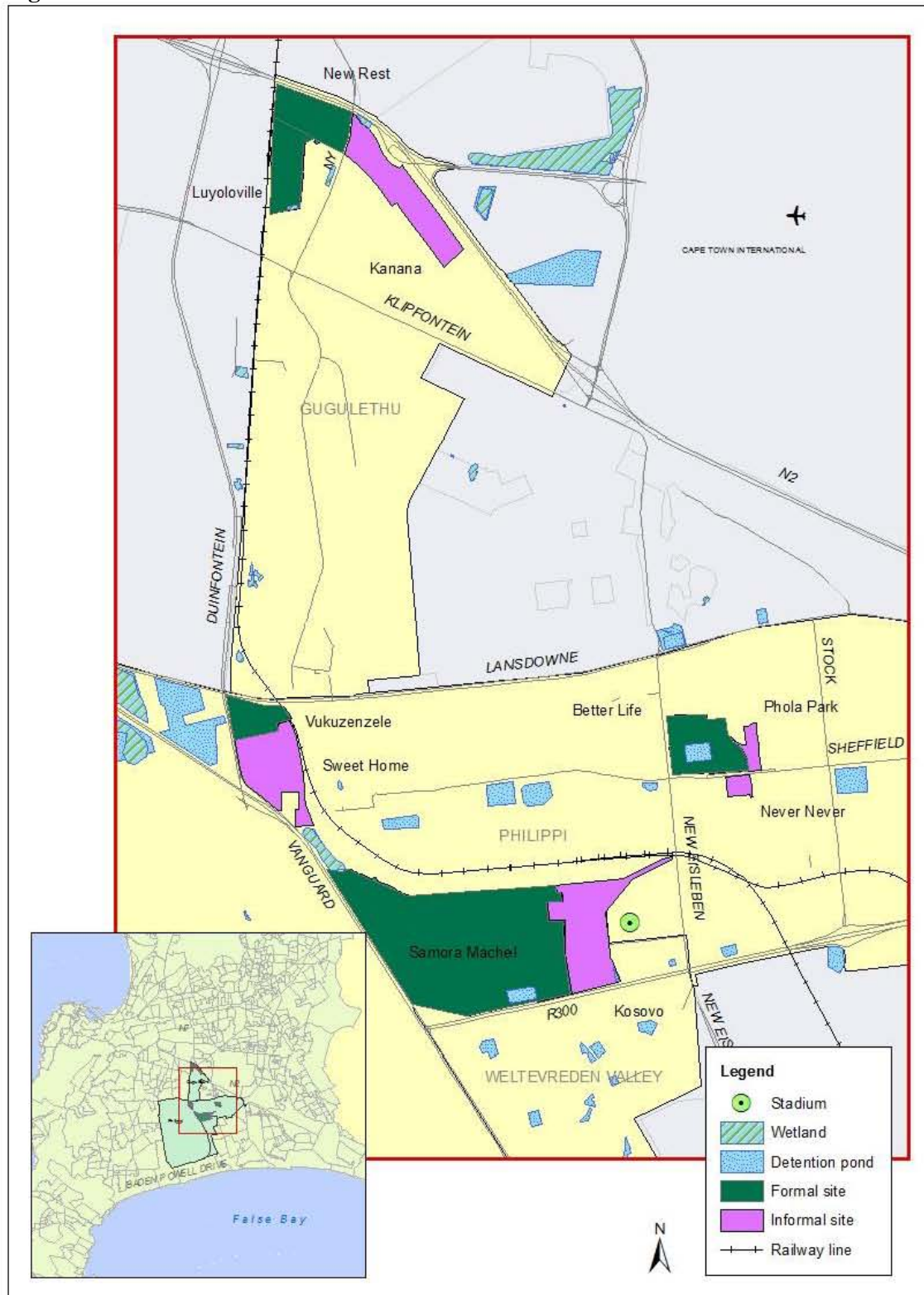


Source: Romanovsky and Gie, 2006

Marginal land, marginal space: Locating the research areas geographically and socially

Geographically, the research areas lie to the southeast of the City Bowl. Seven of the sites are located in greater Philippi, an area bounded by Lansdowne Road, Duinefontein Road, the N7 (Vanguard Drive) and the R300 (Figure 10). These sites include the informal settlements of Kosovo, Never-Never, Phola Park and Sweet Home, and the formal settlements of Better Life, Samora Machel and Vukuzenzele, with parts of Samora Machel and Kosovo falling within Weltevreden Valley. Three sites are located in Gugulethu, to the north of Philippi: the informal settlement of Kanana and the formal settlements of Luyoloville and New Rest. The sites lie close to Cape Town International Airport, to the south of the N2 Freeway.

Figure 10: Location of the research sites



As with other areas on the Cape Flats, Philippi and Gugulethu lie on marginal land. The Cape Flats were once a shallow sea separating the Cape Peninsula from the high ground of the interior, and now comprise a flat, sandy, poorly-drained plain (Adlard, 2008), dotted with permanent and seasonal wetlands and other waterbodies. Gugulethu shares many of these geological and hydrological features, but large portions also lie on old landfill sites (Fuggle, personal communication, November, 2010), including the three sites selected. Rapid urbanisation has disrupted natural drainage patterns and increased stormwater run-off in both areas, but a key source of flooding is the high water table (Ziervogel and Smit, 2009), particularly in Philippi. The water table lies within only one to three metres from the surface in the dry summer months, and can rise by one to two metres in the wet winter months (Wessels, 1981), often rising and remaining above ground level for months at a time. The presence of the landfill sites in Gugulethu presents additional challenges, such as subsidence, and may compound poor drainage in affected communities (Fuggle, personal communication, November, 2010).

The study area slopes gradually downwards from east to west. Figure 11 (page 123) shows the elevation of the research areas, with pink, purple, and light blue showing lower-lying areas and red, orange and yellow showing higher areas. It indicates that, although Philippi and Gugulethu are relatively low-lying overall - the maximum height is 73 m above sea level – the sites are quite diverse. Never-Never, Phola Park and Better Life are the highest, with an average elevation of between 37 m to 40 m above sea level. Kosovo and Kanana follow, at approximately 30 m to 36 m, with Samora Machel and Sweet Home at an average elevation of roughly 30 m above sea level. New Rest Luyoloville and Vukuzenzele lie at the lowest end of the site-spectrum, with an average elevation of between 20 m to 25 m. Within-site variation is most pronounced in Kanana, Samora Machel and Sweet Home, where the highest and lowest points in the site vary by more than 20 metres.

Philippi was originally agricultural land, but most is now taken up by informal settlements, subsidised housing and industrial developments. The number of informal settlements and housing projects has grown rapidly since the 1980s, and the area has seen fierce contestation over land and housing, often resulting in violence, particularly in the 1980s and 1990s (Adlard, 2008). Despite the City's efforts to stimulate the

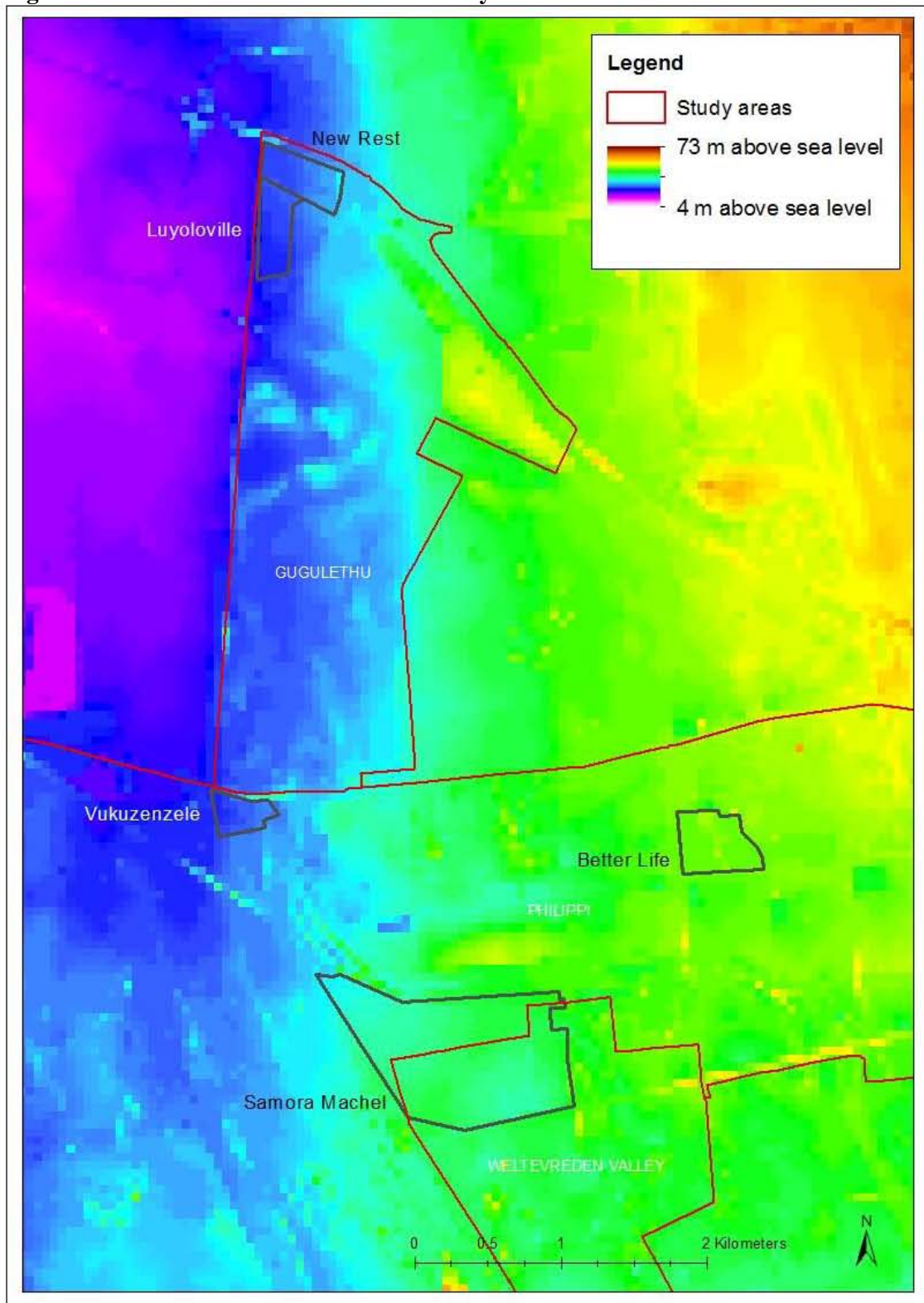
local economy by linking the southeast with Cape Town's wealthier southern suburbs, there remain few economic opportunities (Turok, 2001). Philippi, as with many of the other suburbs in the southeast, remains a largely dormitory area, with limited private investment and an economy dominated by small-scale, often home-based traders and producers, with low levels of investment in physical capital (Turok, 2001).

Both areas share a history with the Cape Flats as a whole. Gugulethu is amongst the oldest township areas on the Cape Flats. It was one of the townships established in the wake of the passing of the Group Areas Act, and was established in the early 1960s to help house African workers registered to live legally in Cape Town (Wilkinson, 2000). Gugulethu lies closer to the City Bowl and Cape Town's northern suburbs than Philippi and has seen a rapid expansion of informal settlements.

Much of the housing built in both Gugulethu and Philippi between the early 1990s and early 2000s was built under the Integrated Serviced Land Project (iSLP). Initially called the Serviced Land Project, the iSLP was established in 1991 (Turok, 2001). It was mandated to provide serviced residential sites for homeless households in 30 communities in and around Langa, Gugulethu, Nyanga, Crossroads and Philippi through inclusive and participative processes (Adlard, 2008). This included the residents of more than 20 informal settlements, as well as some households living in backyard dwellings or derelict hostels or who were registered on long-standing municipal waiting lists (Seekings et al, 2010).²⁵ A total of 32 500 dwellings were built under the project. In addition to housing, the iSLP was supposed to provide integrated infrastructure, community facilities and job opportunities to create sustainable and habitable areas, but achieved less success in achieving these objectives as the "areas remain rather inhospitable living environments with large amounts of vacant land and no landscaping" (Turok, 2001:2369).

²⁵ 'Backyard' dwellings refer to informal dwellings built in the front- or backyard of formal dwelling sites. While these sometimes provide additional space for housing beneficiaries, these structures are often rented out to tenants, and often serve as an important source of income in subsidised housing areas.

Figure 11: Elevation levels in the ten study sites



Experiences in common and apart: The history and characteristics of the research sites

This section describes the histories and characteristics of the ten sites. The research sites fall into four clusters, based on their location: one cluster in *Gugulethu*, comprising *Kanana* informal settlement and the formal areas of *Luyoloville* and *New Rest*; one cluster in *Philippi East*, consisting of the informal settlements of *Never-Never* and *Phola Park* and the formal settlement of *Better Life*, otherwise known as *Philippi Park*; a cluster in *Philippi's Weltevreden Valley*, comprising *Kosovo* informal settlement and the formal housing area of *Samora Machel*; and, to the northwest, the informal settlement of *Sweet Home* and the formal area of *Vukuzenzele* (see Figure 10). The section examines the issues that have shaped the settlements in each of the clusters, and provides a summary of the dominant housing type, size of the settlement and its history.

Cluster 1: The Gugulethu cluster

Kanana is amongst the oldest of the informal settlements selected. It was established in the early 1990s. The settlement occupies a thin strip of Council-owned land lying between the N2 highway and the NY1 (renamed Steve Biko Drive in September 2012), a key thoroughfare through the suburb of Gugulethu. It also borders a wetland that is adjacent to the highway. Aerial photographs from the late 1990s onwards suggest relatively limited densification compared to the other selected areas. Community leaders concur, arguing that although the settlement has seen some growth over the last five years, primarily due to the upgrading of *New Rest*, the population as a whole has remained stable over the last decade. In 2007, the City of Cape Town estimated that the settlement contained approximately 2 675 dwellings.

New Rest is an in-situ informal settlement upgrading development. The settlement lies adjacent to *Kanana*, to the west of the NY1. *New Rest* was one of the pilot sites identified for development under the BNG. The upgrading of *New Rest* informal settlement began in 2007 under the auspices of the N2 Gateway Project (Government

of South Africa, 2010) and was still underway at the time of the research, although most dwellings had been completed. The project involved the upgrading of just over 15 hectares of land, and approximately 1 300 informal dwellings. At the time of writing, 662 fully subsidised houses had been handed over to beneficiaries. An additional 445 dwellings were under construction. These comprised a mix of contractor-built and PHP dwellings (HDA, 2011). The contractor was ASLA Construction.

As with many other settlements built under the UISP programme, the site lies on rehabilitated land. The UISP aims to preserve social and economic networks by minimising relocation, and provides for additional funding to address geo-physical problems that would otherwise make sites unsuitable for development. These measures include enhanced drainage, building stormwater infrastructure and the engineering of slopes, with many sites built in “areas with extremely high water tables, settlements situated on floodplains and settlements located on infill areas or near mine dumping sites/slime dams” (Department of Housing, cited in Huchzermeyer, 2007:50). As noted earlier, *New Rest*, together with *Kanana* and *Luyoloville*, lies on a landfill site. Efforts to address potential concerns in the sites are evidenced by a large drainage ditch dissecting the settlement, drains and some terracing of land.

Adjoining *New Rest* is *Luyoloville*. The settlement is a subsidy-linked housing development comprising 254 erven. It was established in 2000. The Cape Town Community Housing Company (CTCHC), a joint venture between the City authorities and the National Housing Finance Corporation, built the dwellings. The development targeted the ‘gap market’ in subsidised housing: households earning more than the maximum R 3 500 (US\$ 400) per month required to qualify for a regular housing subsidy, but too little to enter the traditional housing market. Gap housing is billed as superior to regular subsidised housing and a step up from RDP-type developments (Zweig, 2006).

In common with several other developments built under the auspices of the CTCHC since 1999, tenure, procedural and quality issues have plagued the settlement. Most pertinent to this research, it is alleged that the company failed to adhere to national building procedures and standards. Eight settlements, including *Luyoloville*, were not

built according to the terms of National Housing Code, and were never inspected, allowing for the use of poor-quality materials and substandard building practices (Zweig, 2006). Research conducted in 2006 found that the company employed only one full-time, trained civil engineer to oversee the simultaneous building in each of the eight settlements and uncovered reports of poor building practices, including hastily thrown flood slabs and inadequate monitoring (Zweig, 2006).

Cluster 2: Never-Never, Phola-Park and Better Life

Never-Never is a small informal settlement bordering Sheffield Road in Philippi East. The settlement - designated Area K by development planners – was established in 2001. It was the City of Cape Town’s first Temporary Resettlement Area, established primarily to house people displaced from *Kosovo* and *Sweet Home* by severe flooding (DiMP, 2009b). The land is owned by the City of Cape Town and was originally intended for a detention pond (Adlard, 2008).

Never-Never has since grown into a permanent informal settlement. Initially consisting of 335 partially serviced residential sites, the settlement grew to 585 dwellings by 2005 and 634 dwellings in 2007 (City of Cape Town, no date). By 2009, the number of houses was estimated to be close to 800 (DiMP, 2009b). The settlement lies on a gradual slope and densification has increased the amount of run-off and pooling associated with heavy rainfall, with residents reporting that closely packed houses prevent water from draining naturally.

Phola Park (Philippi) is the oldest of the informal settlements examined.²⁶ The settlement was established in 1989, although the current site - located between the new *Better Life* housing development and a bus depot - lies on the remnants of a much larger piece of land of the same name, and was established in 2001 (DiMP, 2009b). It is opposite *Never-Never*, to the north of Sheffield Road. Many founding households were ‘backyarders’ (people living in backyard shacks) from areas such as

²⁶ There are several Phola Parks on the Cape Flats, including a settlement in Mfuleni, close to the research site. “Phola” means to relax in isiXhosa, with a number of settlements established by young people seeking their own dwellings away from their parents (DiMP, 2009b).

Gugulethu, Crossroads and Khayelitsha, as well as the greater Philippi area (DiMP, 2009b). According to the City of Cape Town there are currently about 1 350 families living in the settlement (DiMP, 2009b). The site lies on council land.

The *Better Life* housing development, otherwise known as Philippi Park, is a phased, in-situ informal settlement-upgrading project, built after the introduction of BNG. Approximately 400 households from the greater *Phola Park* area were allocated houses (DiMP, 2009b), while some were families relocated from other informal settlements following flooding in 2001. The City of Cape Town initially established 1 275 serviced sites of 100 m² with a toilet structure and a tap, on which beneficiaries could re-build their shacks. These were upgraded in a second phase through the government's housing subsidy programme (Adlard, 2008). Some households from *Never-Never* also reportedly received houses.

The first houses were delivered in 2008. Plans for the development were passed in 2007 and the first 500 units were completed between June and December 2008. Construction on a final cluster of houses along the settlement's southern boundary was underway in January 2011 when the fieldwork was conducted for this study, but this area was not included in the research. Two companies built the houses: L. Martin Construction and New Africa Construction (SAAH, 2009).

Cluster 3: Kosovo and Samora Machel

Kosovo is the largest of the informal areas. It was established in 1994. It is a densely populated settlement situated on 25 hectares of council-owned land on the Eastern side of Weltevreden Valley in the greater Philippi area (DiMP, 2009a). Prior to 1994, the land was privately owned and home to a small number of informal dwellers. The current settlement was established in 1994 following a planned land invasion. The settlement grew rapidly, particularly after a second, larger land invasion in September 2000. A 2004 survey by ARG Design identified 5 264 dwellings and a population of over eleven thousand people. Today there are over 5 400 houses with a gross density of around 210 dwellings per hectare (DiMP, 2009a).

It is also one of the most flood-prone of the informal settlement sites. The land was previously covered by dunes and wetlands and, despite the provision of stormwater drains, parts of the settlement remain poorly drained, particularly along the settlement's northern periphery. *Kosovo* frequently experiences significant flooding during winter and tops the DRMC's list of the Top 20 Flood-Prone Informal Settlements.

Samora Machel is a large settlement, containing a range of housing types. Most housing – over 4 000 dwellings – comprises a greenfield development built under the iSLP in the mid- to late-1990s. These consist of small, freestanding dwellings, some built with concrete blocks and others with pre-cast concrete panels, known as vibracrete (Adlard, 2008). The settlement also contains medium-density semi-detached and row housing. Bordering Oliver Tambo Drive, at the centre of Weltevreden Valley, these 619 dwellings were also developed under the auspices of the iSLP, to provide housing for families relocated from Crossroads, Gugulethu, Langa, KTC and surrounding areas as part of the iSLP programme. Completed in 2001, the development was regarded as an experimental or pilot project for higher-density housing in the Western Cape. While beneficiaries wanted freestanding dwellings, a shortage of land necessitated a more space-efficient approach (Tonkin, 2008). The settlement also contains some informal dwellings and a few privately built dwellings.

The research examined both types of subsidised housing. As with the other study areas, aerial photographs were obtained for *Samora Machel*, and the site was divided into several similar-sized segments, often using geographical features such as roads and other clearly visible landmarks. Four segments were then chosen at random for further study. As Figure 12 shows, the segments chosen in *Samora Machel* (outlined in purple) contained both the early iSLP housing (unmarked) and the more recent medium density housing (marked in red).

Figure 12: Segmentation of Samora Machel showing different housing types



Cluster 4: Sweet Home and Vukuzenzele

Sweet Home lies on what was originally agricultural land, although prior to becoming an informal settlement it was used as a dumping site for building rubble (Del Mistro and Hensher, 2009). It is also referred to as Sweet Home Farm after the original homestead. It covers approximately 17 hectares and is situated at the southern end of Duinfontein road, bounded by the Nyanga railway line to the east, Landsdowne Road to the north and Vanguard Drive to the southwest (DiMP, 2009c). The settlement lies on a number of different erven: some private land, some belonging to the South African Rail Commuters Corporation (SARCC), and the remainder to the City of Cape Town. The result is spatially differentiated provision of services, as the private landowner has refused the City permission to provide electricity or essential services on his land (DiMP, 2009c) – although the City recently obtained his consent. The settlement has a substantial depression in the centre where water tends to pond in winter (Adlard, 2008).

Sweet Home was established in 1992 and has grown rapidly. By 1996 there were 373 houses in the settlement, with this number more than doubling over the next two years

to reach 886 (Abbot and Douglas, 1999, cited in Adlard, 2008:17). By 2004 a survey by the City authorities showed that there were 2 217 dwellings. It was estimated that by 2009 this might have increased to almost 4 000 – reportedly over 17 000 people (DiMP, 2009c).

Vukuzenzele lies immediately to the northwest of *Sweet Home*. The first dwellings were built in 1998. The settlement is currently home to 236 households, but new houses are being built and there are plans for a crèche and old-age home. The project used the PHP model. The development process was initiated by the landowner, who approached FEDUP – then the South African Homeless People’s Federation - for assistance in identifying beneficiaries (Cuff, personal communication, November, 2010). The project was pre-financed through the Utshani Fund, and FEDUP helped to guide the project (SDI South African Alliance, no date).²⁷

As noted in Chapter 3, the PHP provides the main alternative to the dominant contractor-built turnkey housing associated with the government’s housing programme. The PHP was adopted by the Minister of Housing in 1998 (Tissington, 2010) and was developed partly in response to lobbying by civil society organisations like FEDUP and the United Nations. The PHP aims to work with NGOs in the housing sector to assist communities in planning and building their homes using their own labour, or ‘sweat equity’. Rather than going to contractors, the subsidy is paid to vetted Support Organisations that administer the funds and provide logistical and administrative support to the beneficiaries. The underlying concept is that individuals, families or groups can “get more for less” (Human Settlements, 2009:18) from their subsidy, while also having more control over how the money is used.²⁸

²⁷ The Utshani Fund is an accredited financial intermediary of the subsidy system, and is the largest single PHP-oriented institution in South Africa. The Fund sources capital from international donors, with some contributions from government. It was the brainchild of FEDUP, and was established in 1995. The goal was to donate capital to pre-finance innovative community-based housing delivery and design so as to provide examples of alternative, improved housing delivery along PHP lines. The Fund recovers bridging loans through subsidy applications (SDI South African Alliance, no date).

²⁸ The government replaced the PHP with the Enhanced PHP (ePHP) in 2008. The ePHP extends the definition of self-help beyond ‘sweat equity’, and enables beneficiaries to use PHP allocated subsidies for contractor-led developments (Himlin, 2008). In practice, however, many PHP beneficiaries already used local builders prior to this policy shift (Bolnick, 2009)

A patchwork of experience: Summarising the sites' histories

Table 10 summarises the key characteristics of each site. As it shows, the informal settlements are all well established and are, with the exception of Sweet Home, located on government owned land. Being positioned on public land allows for the provision of essential services, including basic drainage facilities, water and sanitation services, and solid waste removal. Some of Sweet Home lies on government land, and some on privately owned land. This has until recently precluded the provision of services to the privately owned parts of the settlement, although the City of Cape Town recently obtained permission from the landowner to rollout basic services.

The subsidised housing settlements are more diverse. The formal sample represents several different housing types, built at different times, under the auspices of different housing models, including the RDP programme, the BNG and the PHP, with New Rest developed under the auspices of the larger N2 Gateway project. In form, the sites include developments built by contractors and self-builds, and span standardised 'RDP'-type housing, more upscale gap-housing and the variable housing forms characterising PHP settlements. As noted in Chapters 3 and 4, these housing types and models allude to potential differences in the design of dwellings and settlements, the quality of buildings, and the location of settlements that could influence their levels of risk. This expands the analytical scope of the research and allows analysis of how the particular history and type of settlement may shape the extent and nature of flooding in subsidised housing areas.

Table 10: Summary of site characteristics

Site	Type	Nature	Approximate dwelling count	Established
Kanana	Informal settlement	Government land	2675	Early 1990s
Kosovo	Informal settlement	Government land	5400	1994
Never-Never	Informal settlement	Government land	800	2001
Phola Park	Informal settlement	Government land	1350	1989
Sweet Home	Informal settlement	Partly private land	4000	1992
Better-Life	Formal settlement	Informal settlement upgrade	860	2008

Luyoloville	Formal settlement	Contractor-built housing	254	2001
New Rest	Formal settlement	Informal settlement upgrade; some PHP	662	2008, ongoing
Samora Machel	Formal settlement	Contractor built	4256; 619	1996; 2001
Vukuzenzele	Formal settlement	PHP	236	1998

Physical and social fragilities: The characteristics of the dwellings and households

This section examines the specific characteristics of the dwellings and households included in the survey. It draws on the survey data to describe the physical and architectural attributes of the dwellings included in the study, as well as the demographic and socio-economic features of each household. It lays the foundation for the descriptive analysis of the data presented in Chapter 6, and the statistical analysis discussed in Chapter 7.

The physical characteristics

The sample consisted of 500 households: 250 households living in an informal dwelling and 250 households living in a formal dwelling, with or without an attached front- or backyard dwelling. Only 25 (5%) of the formal houses had an attached dwelling. The majority of these were in Samora Machel (64%), although there were some in Better Life (20%) and Luyoloville (12%). There was only one (4% of the sample) in New Rest. The majority of formal dwellings (96%) were single story stand-alone houses, with a small number of semi-detached homes or flats in Samora Machel and Vukuzenzele.

The informal dwellings had similar physical characteristics. The majority (81%) were constructed primarily of corrugated iron, the remainder of wood. As Table 11 shows, most also had flat, corrugated iron roofs which tended to only slightly overhang

dwellings' exterior walls. There was relatively little space between dwellings, in most cases (92%) less than one metre. Four out of every five (76%) had either bare cement floors or cement floors covered with some kind of liftable flooring, such as loose carpeting or vinyl. Floors tended to be at ground level (74%).

The formal dwellings were more varied. The dwellings in Better Life and New Rest comprised uniform 'RDP'-type houses, but Luyoloville, Samora Machel and Vukuzenzele contained dwellings using different designs, and in the case of Samora Machel and Vukuzenzele, materials. The majority of houses (84%) had plastered walls built of concrete blocks or, less commonly, bricks, covered with plaster. Several houses in Samora Machel had walls made from pre-cast concrete, known as vibracrete. Most dwellings had A-shaped roofs, which tended to be tiled (60%) or made of corrugated iron (29%), with some in Samora Machel reportedly constructed of asbestos. The majority of dwellings had tiled floors (54%) or cement floors (35%) covered with liftable flooring.

As discussed further below, many dwellings do not meet the standards recommended by government's building regulations and many practitioners. The extent to which the roof overhangs a dwelling's external walls plays a key role in preventing water from driving rain reaching walls, but most dwellings' roofs (75%) extended less than the recommended 60 cm over the side external walls. This was particularly so in the large standardised developments, such as Better Life and New Rest. While it was not possible to verify in the visual survey whether and how well floors were damp-proofed, it was evident that less than half (43%) were above ground or street level. Most formal dwellings (92%) did have insulated ceilings, but houses in Samora Machel and Vukuzenzele were less likely to have them than in other areas (32% and 82% respectively). In Better Life, there were often no panels or trap doors covering access points.

Build-times varied considerably between sites. As one measure of the quality of the building process, respondents were asked how long it had taken to build their dwelling. The resulting figures varied widely, even within sites, suggesting that many people did not know or recall accurately the amount of time that went into building their dwellings, particularly in RDP-type housing. In an effort to overcome these

discrepancies, the reported build-times were averaged for each site. These averages suggest that Luyoloville and Better Life had the shortest build-times, with top-structures reportedly taking seven days or less to complete. Dwellings in Vukuzenzele and Samora Machel took longer, between two weeks and a month, to build. Average build-times were highest in New Rest, where houses took roughly six weeks to complete.

Few subsidised dwellings had any kind of drainage infrastructure. Only one fifth (22%) of houses had guttering, virtually all of which were in Luyoloville (91%) and Vukuzenzele (7%). However, none of the gutters in Luyoloville led into a purpose-built drain or channel to carry rainwater away from the dwelling. The gutters simply drained water from the roof into the yard. Many parts of Luyoloville are very flat, with the result that water pooled around the dwelling, rather than draining away. Many dwellings had concrete aprons around them but, due poor building standards, some of these sloped slightly towards the house, directing water towards the dwelling and exacerbating the problem. Only one fifth (19%) of houses – and 16% of those without guttering - had any other formal drainage infrastructure on the plot.

Table 11: Key physical characteristics of the selected households

	Informal		Formal	
	N	%	N	%
Main material used for the walls				
Plastered blocks/bricks	-	-	211	84.4
Unplastered blocks/bricks	-	-	16	6.4
Vibracrete panels	-	-	23	9.2
Corrugated iron	202	80.8	-	-
Wood	48	19.2	-	-
Main material used for the floor				
Bare cement	37	14.8	28	11.2
Cement with liftable flooring	152	60.8	87	34.8
Tiles	2	0.8	134	53.6
Earth or sand	23	9.2	1	0.4
Other	36	14.4	-	-
Height of floor relative to ground/street level				
Same height	185	74.0	136	54.4
Below	23	9.2	6	2.4

Above	42	16.8	108	43.2
Main material used for the roof				
Corrugated iron	245	98	73	29.2
Tiles	-	-	149	59.6
Plastic sheeting	5	2.0	1	0.4
Asbestos	-	-	27	10.8
Type of roof				
Flat	166	66.4	34	13.6
Sloped	84	33.6	27	10.8
A-shaped	-	-	189	75.6
By how much the roof overhangs the exterior walls				
30 cm or less	104	72.7	160	75.1
31 – 60 cm	39	27.3	50	23.5
61 cm or more	-	-	3	1.4
Space between house and neighbouring dwellings				
50 cm or less	114	46.0	56	22.4
51 – 100 cm	115	46.4	66	26.4
101 cm or more	19	7.7	128	51.2

Adherence to norms and standards for subsidised housing

As part of its efforts to improve the quality of dwellings, the government requires contractors and developers to adhere to norms and standards in the construction of subsidised housing. These norms and standards are based on testing by the South African Bureau of Standards (SAB) and Agrément South Africa, as well as the experience accumulated in the implementation of the housing programme. The standards aim to ensure dwellings are an acceptable size and design, are able to withstand the elements and safeguard the health and well-being of their occupants.

By law, all developers and contractors must register with the National Home Builders Registration Council (NHBRC).²⁹ They must also comply with minimum standards

²⁹ The purpose of the NHBRC is to protect the interests of homeowners and regulate the home building industry. It was established in 1998, in accordance with the provisions of The Housing Consumers Protection Measures Act (Act No. 95 of 1998). The NHBRC certifies builders who meet regulated industry criteria for technical, construction and financial capabilities. All homebuilders should register

established by the NHBRC, the National Building Regulations (NBR) and the National Housing Code, or risk being de-registered and prevented from building for a period of five years. These norms and standards have not in the past extended to houses built under the PHP (Ogunfiditimi, 2008; Ntema, no date), although many support organisations such as FEDUP have developed their own minimum standards. However, the revised Building Code (Human Settlements, 2009) now extends the regulations to this sector.

The National Housing Code summarises the technical specifications with which subsidised housing must comply. With respect to stand-alone dwellings, the Code stipulates standards for dwelling size and facilities, site preparation and sub- and top-structures. With respect to flooding, key specifications include:

- **Site preparation:** A geological survey must be completed. Finished ground must direct water away from the building.
- **Floor slab:** Floors must be water-resistant and prevent water from the ground or foundations from penetrating the slab. Agrément South Africa specifies that floor slabs must be laid over a suitable damp-proof membrane to prevent rising damp (Agrément South Africa, 2002a).
- **Walls:** Walls must resist the penetration of water and cement masonry must be at least 14 cm thick. With specific reference to damp, the Code stipulates “it is very important that all new housing is damp-proofed and the quality of concrete blocks is controlled to ensure that they do not absorb water” (2010:46).
- **Roofs:** Roofs must be durable and waterproof and prevent the accumulation of water on the surface.

with the NHBRC and all homes must be enrolled 15 days prior to the commencement of building (see www.nhbrc.org.za).

- **Finishing:** Amongst other finishings, there must be sufficient space for a minimum 60 cm apron surrounding the building.

Overall, buildings should be designed and constructed to prevent visible damp. In this respect Agrément South Africa argues, after considering the available evidence on the medical implications of damp, “no dampness should be visible on the inside face of external walls of a building for human habitation under normal weather conditions” (2002a:1).

As noted in Chapter 4, Cape Town falls within the SCCPA and should comply with an additional set of standards. The SCCPA comprises parts of the Southern Cape where dwellings are prone to severe, potentially health-impacting condensation (Agrément South Africa, 2002). National Building Regulations require houses in this zone to have ceilings with insulation (Human Settlements Department, 2009), while good practice encourages the inclusion of cavity walls, waterproof plaster and paint, and windows with a water-resistant finish (Cuff, personal communication, November, 2010).

Cavity walls are a key precaution. If constructed properly, cavity walls prevent water from penetrating a dwelling’s internal walls. They consist of a double-skinned wall with a gap, or cavity, in the middle designed to prevent water rising into the wall from the ground or penetrating from the exterior wall (see Appendix 4 for an illustration). The gap prevents water that penetrates the external wall from reaching the internal wall, while drainage points in the cavity drain water back out of the external wall.

However, official guidelines often lack detail on how specifications should be implemented in practice. The Building Code for, instance, states that external walls ‘should remain dry’, but does not specify the need for guttering or by how much roofs should overhang external walls to prevent rain water from soaking the walls (Wust, personal communication, November, 2010).

Unofficial norms and standards for subsidised housing

Practitioners involved in PHP housing often have their own standards. These are informed by their experience in developing dwellings, and often aim to ensure a better product than the basic, minimum standards required by government. FEDUP, the largest supporter of PHP housing in South Africa, elaborates several additional guidelines to the national frameworks. These include:

- **Roofing:** all roof sheets must be asbestos-free. Roofs should be pitched at a minimum of six degrees. Roofs must have a minimum overhang of 15 cm.
- **Floor slabs:** on flat or gently sloping ground, floor slab levels should be a minimum of 20 cm above the lowest kerb on the property.
- **External walls:** Walls should be at least 14 cm thick. In the SCCPA, external walls must be plastered on the outside. The plaster should be a minimum of 1.2 cm thick (Cuff, personal communication, November, 2010).

The Cooperative Housing Foundation also has additional guidelines. Key specifications include that floor slabs should always extend above ground level to prevent water entering the house; roofs should overhang external walls by at least 60 cm; and dwellings built on a slope should have a raised apron around the house that directs water away from the walls (Reek, cited in Development Action Group, 2003). Others include that the foundation be laid on a damp-proof membrane, on clean sand on well-compacted fill; that the finished floor level be a minimum of 15 cm above ground level; and that dwellings be built using concrete bricks. They also note that roofs should slope by a minimum of 5 degrees (Development Action Group, 2003).

An architect interviewed during the course of this research reiterated several of these points. Based on his involvement in numerous PHP projects, he argued that roof design and waterproofing are critical in Cape Town. He maintained that roofs should have an overhang of at least 60 cm in order to withstand the strong winds and driving rain that often accompany storms in the city. The floor slab should be above ground level, and floor slabs and walls should all be lined with waterproof membranes (Cuff, personal communication, November 2010).

That many dwellings fail to adhere to either official or unofficial standards suggests that households may be vulnerable to flooding. Insufficiently large roof overhangs, for instance, may allow rain to drive against external walls, increasing the likelihood of water penetrating, particularly where walls are unplastered. Similarly, it may be easier for water to enter dwellings without raised floors, especially in areas where run-off and ponding are concerns. More generally, the obvious failure to meet minimum standards such as the size of roof overhang, suggests not only non-adherence in other areas such as damp-proofing, but also inadequate monitoring and oversight by building inspectors, raising questions about the quality of the buildings.

Socio-economic characteristics

Households had generally lived in the settlement and their home for some time. As Table 12 shows, the majority of those in both the informal (71%) and formal sample (80%) had lived in the settlement for six years or more. Most had also lived in their home for longer than five years (63% and 65% for the informal and formal samples respectively). Only 2% of households had lived in their settlement and 6% in their dwelling for the minimum of one year required to be in the study.

The two samples show slightly different socio-demographic characteristics overall. The majority of the households living in informal dwellings were headed by women (54%) while those in formal dwellings were mostly male-headed (60%). Households living in informal dwellings also tended to be headed by younger individuals. Almost four out of every five informal dwelling households (76%) were headed by people in their twenties or thirties. Only one third (37%) of household heads in the formal areas were in this age group, with most aged 40 or over.

Households living in informal dwellings and subsidised housing also differed economically. Households living in formal housing tended to be slightly larger than those in informal settlements (with an average size of 4.2 members compared to 3.5). Disposable income was also higher in formal households (R 1 226 (approximately US\$ 136) as opposed to R 799 (US\$ 89)), but the differences were less when income

was calculated in proportion to the number of people in the household, with formal households showing an average disposable income of R 360 (US\$ 40) per capita compared to the R 299 (US\$ 33) in informal dwelling households.³⁰ Households in informal and formal areas had similar dependency ratios - the ratio of those earning a stable income, whether from employment, self-employment or a grant or pension, to non-earners - with an average of 2 earners for every 3.5 household members in informal settlements and 1:2 in formal areas.

Table 12: Overview of household characteristics

	Informal dwelling		Formal dwelling	
	N	%	N	%
Lived in settlement				
12 – 23 months	4	1.6	1	0.4
2 – 3 years	20	8.0	11	4.4
4 – 5 years	49	19.6	38	15.2
6 - 10 years	110	44.0	106	42.4
11 years or more	67	26.8	94	37.6
Lived in house				
12 – 23 months	6	2.4	9	3.6
2 - 3 years	31	12.4	65	26.0
4 - 5 years	56	22.4	39	15.6
6 - 10 years	100	40.0	81	42.4
11 years or more	57	22.8	56	22.4
Household head's gender				
Male	114	45.6	150	60.0
Female	136	54.4	100	40.0
Age of household head *				
19 or younger	3	1.2	5	2.0
20 - 29 years	78	31.5	20	8.1
30 - 39 years	109	44.0	71	28.6
40 - 49 years	43	17.3	84	33.9
50 - 59 years	9	3.6	46	18.5
60 or older	6	2.4	22	8.9

* One missing case for both the formal and informal sample (n=249 each)

³⁰ Disposable income was calculated from several different questions. In addition to being asked how much money came into their household in an average month, respondents were asked a series of questions on how much they spent on necessities, remittances, bills like water and electricity or rent, transport, medical expenses and insurance in an average month. Disposable income was calculated by subtracting income from expenses.

Similarity and difference: Summarising households' physical and social characteristics

The informal settlements sampled shared similar physical and social characteristics. As in most informal settlements in Cape Town, dwellings tended towards small, closely-packed, box-type structures, built primarily of corrugated iron, with floors at or above ground level. Many dwellings had concrete floors. With the exception of concrete floors, which are likely to prevent seepage better than earthen or sand floors, dwellings appeared to have little in the way of weatherproofing. In keeping with the age of the informal settlements, surveyed households had generally lived in both their settlement and dwelling for several years, suggesting that households are likely to have been exposed to flooding where it occurs.

Households also showed similar social characteristics. The majority of households were headed by women, most of whom were in their twenties and thirties. Women generally, and female-headed households in particular, are widely identified as being more vulnerable to the negative impacts of hazards, suggesting potentially heightened levels of vulnerability in many of the households surveyed (for instance, Fierlback, 1997; Elson, 1991; Kabeer, 1989). Households in the informal settlements tended to be poorer economically than those in the formal settlements, but they also tended to be slightly smaller, which narrowed the differences in per capita income between informal and formal households.

The formal sample was more diversified. As noted earlier, the survey included settlements built under different housing models, and this is reflected in the varying dwelling characteristics. Houses in Better Life and New Rest were highly uniform, while those in the other settlements showed a wider range of characteristics. As discussed earlier, the age of the settlements also varied, although the majority of respondents had lived in the settlement and their homes for several years. While most dwellings had rain-resistant features such as pitched roofs and plastered walls, most also failed to meet best practice standards in key areas promoted by government and practitioners, particularly with respect to double walling and the degree to which roofs overhang external walls, conceivably increasing the risk of water seeping into dwellings during heavy rains. Few had any kind of guttering or drainage infrastructure

to draw water away from the dwelling, which could again increase the risk of flooding. Variable build-times highlight potential differences in the quality of dwellings, with very short build-times in settlements like Better Life and Luyoloville suggesting possibly poorer building practices.

In contrast to the informal settlement sites, households in the subsidised housing areas were most often headed by men, and primarily by men in older age groups. Households were generally slightly better off economically, but per capita incomes were only slightly higher than in the informal sample, pointing to the continued poverty in formal housing areas. Formal and informal households also tended to have similar dependency ratios, which again points to the similar circumstances found in informal and subsidised settlements.

Framing the empirical experience of flooding: Connecting the research context and aims

The discussions in this chapter highlight the socio-economic and physical marginality of the Cape Flats generally, and the research sites specifically. The sites represent a microcosm of the Cape Flats. All are in areas that experience flooding. As with the Flats more broadly, both Gugulethu and Philippi are located on marginal, poorly drained land. Several of the research sites lie on rubble or, in the case of those in Gugulethu, on landfill sites, and most are close to waterbodies. Both areas are low-lying, but the sites in Gugulethu are particularly so, suggesting the potential for flooding, particularly seepage. As with the Flats in general, the research areas and sites are also poor overall, and are likely to be vulnerable to stressors such as flooding. Although households living in subsidised housing were slightly better off financially, incomes were generally low in both samples, and many households showed markers for possibly heightened socio-economic fragility, such as being headed by women or older people.

The subsidised housing sample represents a cross-section of housing types and forms, and is likely to reflect the range of experience in subsidised housing areas. The settlements represent several housing types, built at varying times, under the auspices

of different housing models, including the RDP programme, the UISP and the PHP. The sites include settlements built by contractors and by beneficiaries themselves. They span standardised 'RDP'-type housing, more upscale gap-housing and variable PHP dwellings. These housing types and models allude to potential differences in the design of dwellings and settlements, the quality of buildings and location that could influence levels of risk. This diversity expands the analytical scope of the study, and makes it possible to examine how housing type, and the implied differences in process, may shape the extent and nature of flooding in subsidised housing areas.

The discussions in this chapter illustrate the complex risk environment on the Cape Flats. Read alongside Chapter 3, it highlights the range of factors potentially impacting on flood-risk in informal and subsidised housing areas. These include topographical features, variations in levels of service delivery, socio-economic differences, governance dynamics, building features, adherence to building standards, and levels of monitoring and oversight in the subsidised housing sector. The next chapter begins to examine how these dynamics influence the experience of flooding on the Cape Flats. It presents a descriptive analysis of the survey data, and examines the extent of flooding in formal and informal housing areas, the nature of the flooding and its impact on affected households.

CHAPTER 6

More in Common Than Apart: Rain-Related Problems in Informal and Formal Settlements

Introduction

As discussed in Chapter 2, flooding is generally viewed as a hydrometeorological hazard, with research and practice frequently focusing on its hydrological aspects (for instance, Guha et al, 2012; Jha et al, 2011; Smith and Petley, 2009; ADPC, 2005a; Hewitt, 1997; Alexander, 1993; 2000). In many discussions, the implied causality runs from weather through to inundation, or the flow of floodwater over land that is usually dry. Research on urban flooding has expanded the conceptualisation flooding and introduced a more developmental perspective. Nonetheless, the hazard remains conceptualised in terms of surplus water, with flooding triggered primarily by atmospheric conditions (for instance, Fatti and Patel, 2012; Jha et al, 2012; Sakijege et al, 2012; Benjamin, 2008; Action Aid, 2006).

Discussions on urban flooding frequently focus on informal settlements. Both internationally and locally, households living in informal settlements tend to be considered most exposed and vulnerable to disaster risks generally and flooding specifically, and it is unclear to what extent the emerging typologies capture peoples' experiences in poor formal areas. In Cape Town, those in informal settlements are viewed as vulnerable while those in subsidised housing are not. The provision of housing is seen as a cure-all for a range of developmental challenges, including flood-risk. As discussed in Chapter 3, the authorities and the research community view the provision of housing as the long-term solution to flooding. Households living in flood-prone informal settlement areas also see formal housing as the remedy, and regularly call on government to provide them with dwellings.

There has been virtually no research to test this assumption. As discussed in Chapter 3, two studies conducted in the Western Cape (Benjamin, 2008; DiMP, 2003) suggest that flooding remains a challenge in subsidised housing areas, but neither studied the nature and drivers of vulnerability in depth, nor how households' experiences compared to those in informal settlements. The scarcity of information on flooding in subsidised housing areas implies a gap in our understanding of the urban risk environment, both in Cape Town and in parallel contexts elsewhere. This, in turn, calls into question how well prevailing research and practice capture the range of experience in Cape Town and other urban areas.

This chapter begins to fill this gap. It examines the extent, nature and impact of flooding in informal and subsidised housing settlements. It explores how prevailing constructions of risk in theory and practice compare with households' experiences in subsidised housing areas. The chapter investigates whether households living in subsidised housing are exposed and vulnerable to flooding and if and how their experiences differ from those living in informal settlements. It also explores how the hazard is conceptualised, and the extent to which existing typologies capture the dynamics in subsidised housing areas.

I challenge prevailing assumptions about the extent and nature of flooding, in Cape Town. I show that households living in subsidised housing are exposed and vulnerable to flooding. I illustrate that, although it has a hydrometeorological component, 'flooding' in subsidised housing is most often due to leaks in poorly built dwellings. This results in potentially hazardous damp and mouldy conditions rather than inundation, or water flowing into dwellings. These conditions appear trivial compared to more conventional flood-types, but the findings show that they have a substantial, negative impact on households' well-being and resources, undermining the developmental objectives of the housing programme. Drawing on these findings, I argue that we need to think differently about the nature and parameters of flooding if we are to capture the range of experience in Cape Town, and in contemporary urban environments more broadly.

The chapter begins by examining the prevalence and nature of flooding in informal and subsidised housing, possible sources of vulnerability and the implications for how

we conceptualise the hazard in the local context. It next considers how flooding impacts on households, specifically its implications for households' quality of life and financial resources. It concludes by examining how the emerging picture of flood-risk in subsidised housing challenges prevailing assumptions about hazard and risk.

Leaks versus 'flooding': The extent and nature of flooding in informal and formal settlements

This section examines the extent to which households in formal areas experience flooding and, where they do, the nature of the flooding. Taking Benjamin's (2008) typology as a starting point, the section compares the experiences of households in informal and subsidised housing areas. It examines five categories of flooding, including that due to:

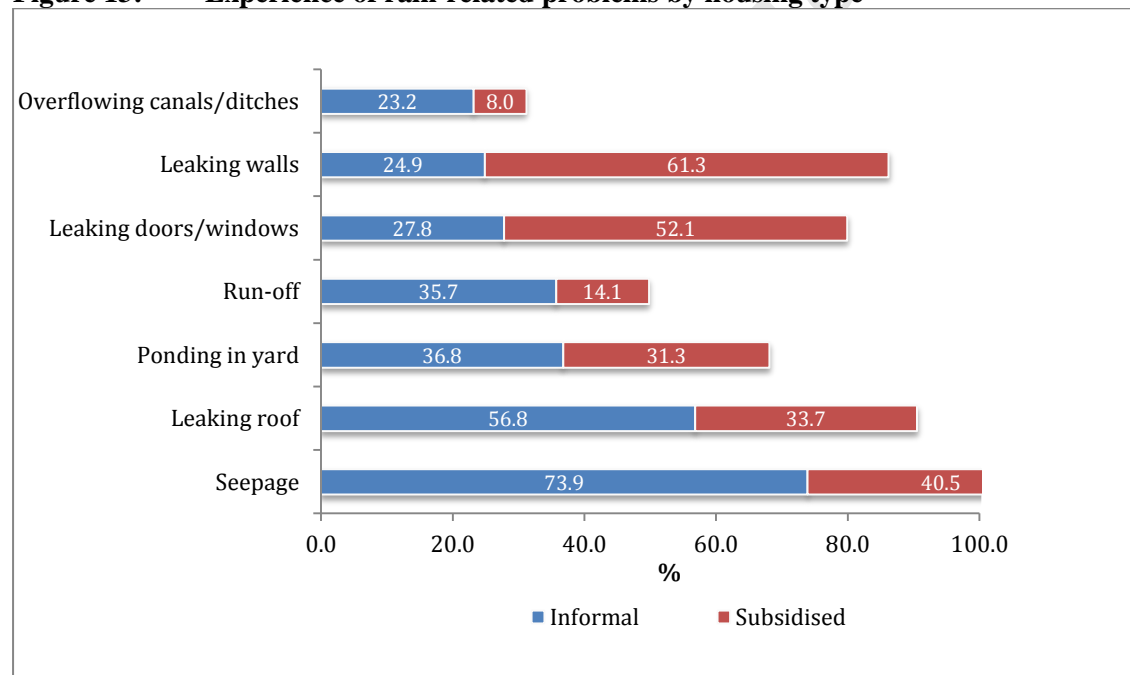
- run-off from roads, streets or slopes;
- overflowing drainage infrastructure;
- ponding;
- a rising water table, or seepage; and
- flooding due to leaking roofs, walls, doors and window-frames.

The findings show that households living in subsidised housing experience flooding. Contrary to the prevailing assumption by authorities, researchers and communities that flooding is not a concern in subsidised housing areas, the findings show that not only do formal households experience flooding, but that it is common. While just over half (59%) of those who experienced flooding lived in an informal settlement, two fifths (42%) lived in a formal settlement. Considered as a proportion of those living in each type of housing, the results show that 230 (92%) of the households surveyed in the informal sites and 163 (65%) of those interviewed in the subsidised housing areas experienced some kind of flooding.

Discussions on flooding in Cape Town focus on conventional flood-types such as river flooding and, to a much lesser extent, issues such as seepage and overflowing

drainage infrastructure, but these are not the primary concerns in subsidised housing areas. Figure 13 shows the percentage of informal and formal households that experienced some kind of flooding. The blue bars represent informal settlements and the red bars formal settlements. In keeping with the literature on urban flooding, households living in informal settlements were most likely to experience ‘rising flooding’, where water seeps up through the floor as rain raises the ground water level (74%), and to a lesser extent leaking roofs (57%). Those living in subsidised housing, on the other hand, tended to experience flooding associated with structural deficits - although seepage was also an issue. Respondents in subsidised housing most often reported leaking walls (61%), followed by leaking around or through doors and windows (52%) and, much further behind, seepage (41%).

Figure 13: Experience of rain-related problems by housing type



Most leaks stemmed from poor build-quality or finishing. As Figures 14a to 14d illustrate, dwellings in subsidised housing areas showed structural cracks (Figure 14a), unfinished roofs (Figure 14b), holes in their walls (Figure 14c) and cracking in both the plaster and concrete around doors and windows (Figure 14d). Several dwellings in Better Life, for instance, had unfinished roofs. This allowed rainwater to seep under the tiles and into the house. Many also had cracked walls. The qualitative research

suggests that although some cracking was due to weaknesses in the walls themselves, most was due to poor plastering, which allows rainwater to seep through external walls. An ex-project manager, previously involved in developing PHP housing, argues that this problem is often compounded by poor masonry and the use of low-quality cement blocks – used extensively in the subsidised housing sector – and bricks. Locally produced blocks, in particular, are often subject to limited quality control and are improperly cured, making them prone to shrinkage and less water resistant (Wust, personal communication, November, 2010). Participants in Samora Machel reiterated this, arguing that ‘cheap blocks’ compromised the quality of dwellings.

Figure 14: Common structural flaws identified in the subsidised housing sites



Figure 14a: Structural cracks and damp in an internal wall (Better Life, October 2010)



Figure 14b: Incomplete roof (Better Life, October, 2010)



Figure 14c) Hole in a concrete wall panel (Samora Machel, November, 2010)



Figure 14d: Cracking around a door frame (Better Life, October, 2010)

Households’ experiences in Better Life and Vukuzenzele illustrate some of these issues. As discussed in Chapter 5, Better Life is a relatively new, phased, in-situ informal settlement upgrading project. It comprises standardised, RDP-type dwellings built by an external contractor. Focus group participants in Better Life reported that each house in the settlement was allocated 15 bags of cement and sand for plastering

the dwelling's external walls, but that most received less than half this number, with the result that the plaster was applied more thinly than it should have been. It was unclear precisely what happened to the missing bags, but participants believed that they were taken by the contractor or builders involved in the project, or by those responsible for distributing them. The results were more severe for some dwellings than for others, but many households had needed to re-plaster walls at their own expense.

In Vukuzenzele, a PHP development, focus group participants attributed problems to limited resources and inexperience. Unlike in RDP-type housing, beneficiaries in PHP settlements are supposed to plan and build their own homes, with the logistical and administrative assistance of a Support Organisation, in this case FEDUP. While the PHP aims to help beneficiaries get more out of their subsidies by using their own labour, very few participating households had any kind of building expertise prior to the project, and although FEDUP provided training, some chose to use local contractors. Many, however, could not afford to hire professional builders, and used cheap, less experienced outfits. Beneficiaries also frequently used cheaper, poor-quality building materials in an effort to make their budgets stretch further.

These findings on the prevalence and nature of flooding in Cape Town challenge assumptions about risk. They show that, while both external role-players and at-risk communities see housing as a remedy for flood-risk, households living in subsidised housing continue to experience problems. They suggest an important gap in the conceptualisation of risk in Cape Town. They show that by assuming that flooding is confined to informal settlements, external actors fail to see the problems in subsidised housing areas. This prevents a comprehensive understanding of urban risk, both in the city and more broadly. As explored further in the next section, these findings also point to the contribution of building design and quality to realised risk. The literature on disaster risk reduction often emphasises societal dynamics, but the findings begin to suggest that the built environment is also a key source of vulnerability in subsidised housing areas and needs to be actively factored in to discussions on flood-risk in Cape Town. Although risk in Cape Town is undeniably rooted in the larger social inequalities that have structured settlement on the Cape Flats broadly, buildings themselves must be considered proximate sources of risk.

A range of experience: Flooding profiles in informal and subsidised housing

This section examines in greater depth the risk profile in the informal and subsidised housing sites. It extends the analysis in the previous section and discusses the kinds of problems experienced by households in the different settlements, and how informal and formal households compare. It also explores how the subsidised housing sites compare to one another, with a view to better understanding potential differences in the experiences of those in dwellings built under different housing models.

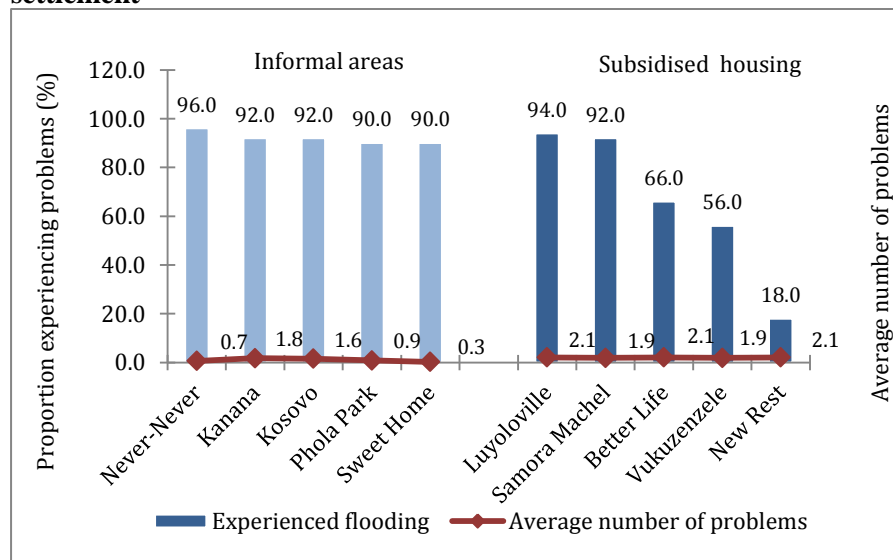
The five informal settlements shared very similar characteristics and showed comparable levels of flooding. Dwellings were built primarily of corrugated iron with nominal weatherproofing, although the owners of some dwellings had laid concrete floors. Settlements were criss-crossed by footpaths and, in places, larger dirt roads, with a handful of tarred roads in some settlements. In keeping with these commonalities, the levels of reported flooding were similar in the informal settlements. Figure 15 compares the percentage of all the respondents in each research site who reported having experienced some kind of flooding. The light blue bars on the left and the dark blue bars on the right represent the informal and formal sites respectively. It shows that the proportion of people experiencing flooding was similar in the informal settlement areas (all between 90% and 96%).

There was considerably more variation in the subsidised sample. Figure 15 shows that households in some of the subsidised housing sites were substantially more likely to experience problems than others. It shows that although the proportion of respondents reporting leaks, seepage and run-off in Luyoloville and Samora Machel was comparable to the informal settlement sites – in fact more reported problems in Luyoloville (94%) than in all the informal sites except Never-Never – only 18% reported problems in New Rest, with Better Life (66%) and Vukuzenzele (56%) lying in between these two extremes.

The number of flood types experienced followed a similar pattern. The lines in Figure 15 plot the average number of flood-types experienced in each settlement. They show that households in both the informal and formal settlements often experienced more

than one type of flooding. They indicate that while households in all five informal settlements experienced an average of two problems, there was more variation in the formal sites. Households in Luyoloville and Samora Machel experienced an average of two problems, while those in Vukuzenzele and Better Life experienced just one. In New Rest, most households did not experience any, resulting in an average of less than one.

Figure 15: The reported incidence and average number of rain-related problems by settlement



The variation found in subsidised housing areas may reflect differences in the age of settlements or, as discussed further below, in the design and quality of buildings. The flood-profiles could reflect the lower than normal levels of rain in the two years preceding the study, but are more likely to result from substantive differences between settlements. As discussed in Chapter 5, upgrading in New Rest began in 2007 under the auspices of the N2 Gateway Project, with households first moving into dwellings in 2008. The low levels of flooding may be partly due to the fact that there have not been any severe weather events since 2008. However, Better Life was also established in 2008, and has far higher levels, suggesting that New Rest is less flood-prone. These differences between sites may reflect their characteristics and histories. As explored in Chapters 3 and 5, the subsidised dwellings in the sample were built under the auspices of different housing models, including the RDP programme, the UISP (BNG) and the PHP. These allude to potential differences in the design of

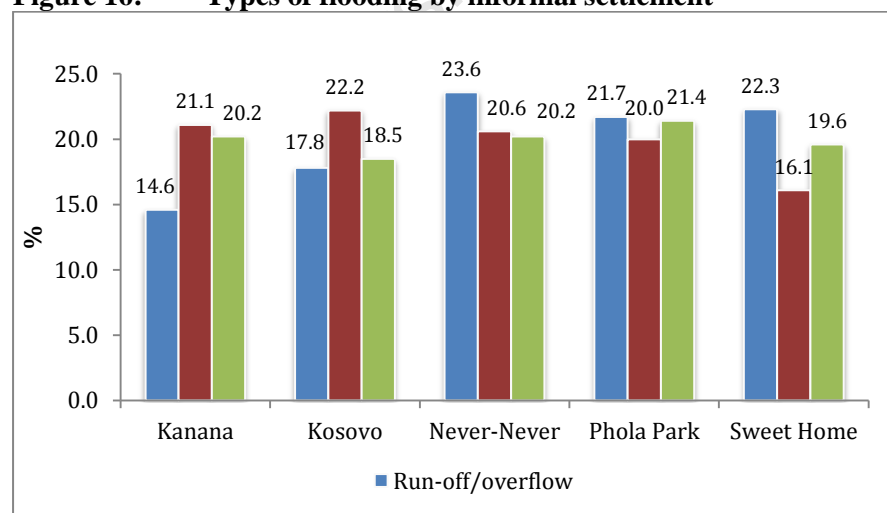
dwellings and settlements, the quality of buildings, and the location of settlements that could influence their levels of risk.

As with prevalence, households in informal settlements reported similar types of flooding. Figure 16 shows the types of problems grouped into three categories:

- Flooding due to run-off from hard surfaces, overflowing drainage infrastructure and ponding in poorly drained areas, referred to as run-off
- Flooding due to water or damp rising up through the floor, referred to as seepage
- Flooding stemming from the poor construction of dwellings or the materials used, referred to as structure-related problems.

These categories are represented on the graph by the blue, red and green bars respectively. The graph shows the proportion of households experiencing flooding in each of the informal sites. It shows that households in all five settlements experienced similar problems, although Never-Never (24%), Sweet Home (22%) and Phola Park (22%) were statistically more likely ($p=.022$) to experience run-off than those in Kosovo (18%) and Kanana (15%).³¹

Figure 16: Types of flooding by informal settlement



³¹ A statistically significant relationship denotes a relationship that results from something other than random chance. Statistical hypothesis testing is traditionally used to determine if a result is statistically significant or not. This provides a "p-value". In general, a p-value of 5% (0.05) or less is considered to be statistically significant, meaning that there is a statistically measurable trend in the data; something is influencing the results in a non-random way.

The qualitative data provides insight into possible sources of flooding. In both Phola Park and Sweet Home it could be linked to identifiable features. In the former, respondents reported that a large earthen drainage canal running along the settlement's eastern border was prone to overflowing in winter, and frequently swamped dwellings near by. In Sweet Home, flooding was linked to concrete drainage ditches running alongside roads in the serviced portions of the settlement. These were often clogged by household refuse and also overflowed. The photograph shown in Figure 17 was taken in mid-summer and shows that, even during the driest months, these ditches were on the verge of over-topping. The structural issues experienced in Kanana were also site-specific, with respondents reporting that their dwellings leaked only when rain was associated with strong winds, which shake structures and allow water to enter through joins in the metal.

Figure 17: Blocked drainage ditches in Sweet Home informal settlement

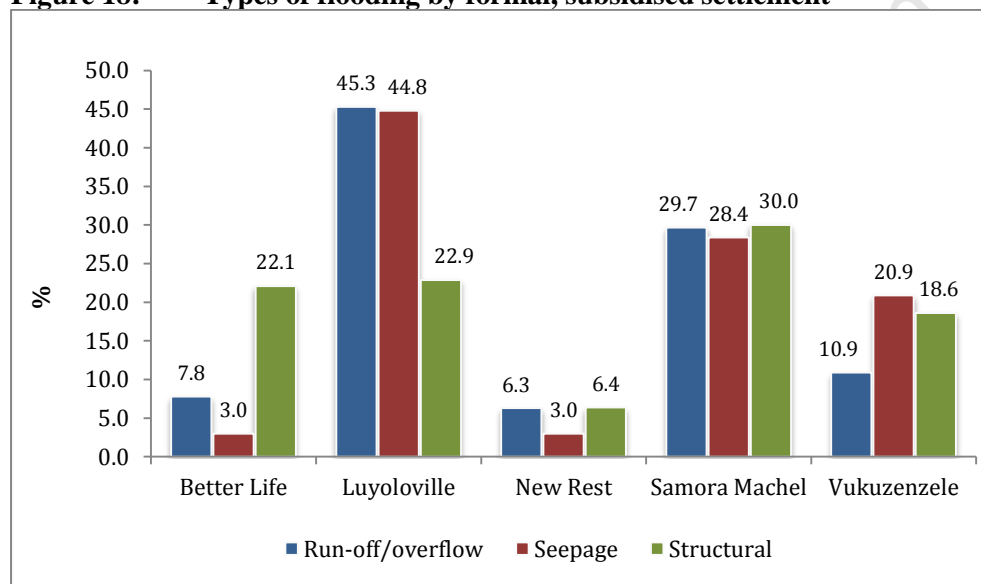


(Sweet Home, November, 2010)

Again, however, flood-profiles varied substantially between the subsidised housing sites. Figure 18 shows the share of households experiencing the different categories of problems in the subsidised housing areas. It indicates that households in Luyoloville were substantially more likely than those in the other sites to experience both seepage and run-off, where almost half of respondents reported these problems (45% for both). Respondents in Samora Machel, on the other hand, were more likely than those in other sites to experience structural problems (30%), with Luyoloville (23%) and Better Life (22%) showing similar levels, and Vukuzenzele slightly lower levels (19%). In keeping with the previous findings, New Rest showed few problems. The differences between sites were all statistically significant (all $p=.000$).

As in the informal areas, flooding was often linked to features of the sites. As discussed later in this section, flooding in Luyoloville, for instance, was often linked to run-off from a large concrete drainage canal running down the eastern side of the settlement, while respondents attributed the high levels of seepage to poorly laid foundations and poor workmanship. In Samora Machel, focus group participants noted that dwellings built with vibracrete – unique to Samora Machel - were more prone to leaks than other dwellings, while in Better Life they pointed to poorly finished buildings, again attributing problems to poor workmanship by the contractor responsible for building the houses.

Figure 18: Types of flooding by formal, subsidised settlement



Examining the situation within sites (rather than the differences between sites) points to the role of structural deficiencies in driving flooding in the formal areas. Figure 19 shows the proportion of all the households in each site that reported rain-related problems, grouped and presented as before. The graph shows that, with the exception of New Rest, the majority of respondents in each settlement experienced rain-related problems resulting from the way in which their dwelling was built or finished. Four out of every five respondents in Samora Machel (84%) reported that their household experienced structure-related problems, as did three out five in Luyoloville (64%) and Better Life (62%) and just over half (52%) in Vukuzenzele. This was more than twice the number reporting other types of problems in Samora Machel (38% for both

seepage and run-off) and Vukuzenzele (28% and 14% respectively) and more than six times the proportion experiencing other problems in Better Life (4% for seepage and 10% for run-off). Only 18% of respondents reported structure-related problems in New Rest, but those experiencing such issues still outnumbered those reporting either flooding due to run-off (8%) or seepage (4%). Luyoloville is the outlier in the sample; while households were still most likely to experience structural problems, only slightly fewer experienced other types of problem (60% for seepage and 58% for run-off).

Figure 19 also suggests that, with the exception of New Rest, households living in contractor-built housing were more likely to experience leaks than those living in housing built under the PHP. Households in Vukuzenzele, the primary PHP settlement in the sample, experienced structural problems, but at lower levels than those living in Samora Machel, Luyoloville and Better Life. This may point to better design and build-quality. While households receiving mass-produced, off-plan, contractor-built housing have little say in how their dwellings are built, it is likely that households in PHP settlements have greater input into the way their houses and settlements are designed, and the types and quality of the materials used. There is also less of a profit-motive, which encourages contractors to cut-corners. The more individualised nature of the PHP may also allow for context-tailored design features - although this is likely to depend on the Support Organisation involved (Cuff, personal communication, November, 2010).

This does not discount the problems that exist in PHP settlements. As noted already, the use of inexperienced contractors and cheap materials compromised the quality of housing in Vukuzenzele. However, the differences between Vukuzenzele and the other settlements highlight the importance of building design in driving risk. Although residents reported leaks, seepage and run-off, the qualitative research suggests that the project benefitted from FEDUP's expertise and experience in the subsidised housing sector. This included advice on points of design, such as larger roof overhangs and extra brickwork to ensure that the floor slabs were well above ground level.

Figure 19: The proportion of all respondents reporting flooding in each subsidised housing settlement

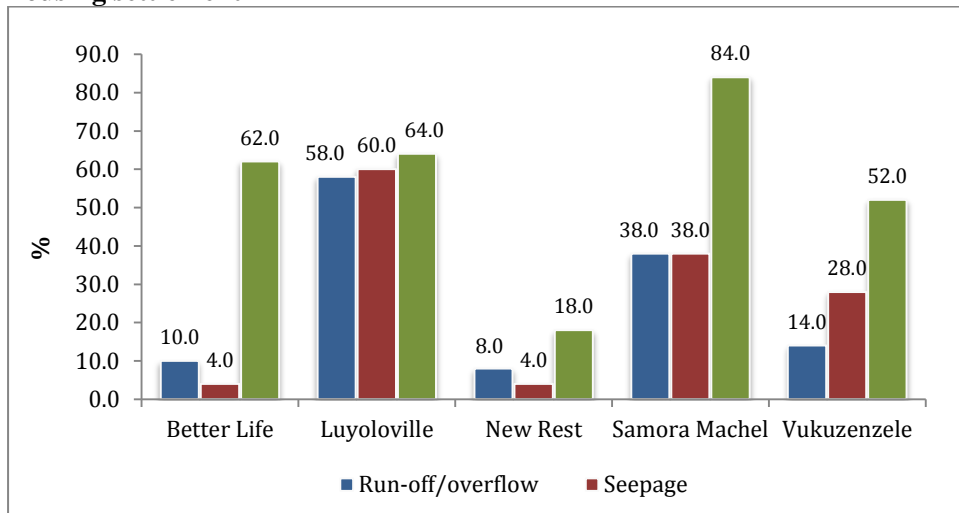


Table 13 summarises the findings on the types of flooding in the informal and subsidised housing sites, including the share of flooding experienced in each site and the main problems in each settlement. It highlights the diversity that exists between the sites, particularly in the formal areas. While levels of flooding were similar in the informal settlements, they varied considerably in the formal sample. The types of problems also differed between sites, and between informal and formal areas. Despite their proximity, adjacent informal and subsidised housing settlements show different levels and types of flooding. This points to the variable nature of realised risk in settlements in Cape Town. These idiosyncrasies highlight the dangers of oversimplifying the conceptualisation of how risk accumulates and manifests at a municipal, city or even neighbourhood scale. As explored in the next section, they suggest that making blanket assumptions about who is vulnerable and to what they are vulnerable obscures the complex, often site-specific dynamics driving risk and, again, prevents a holistic understanding of risk.

The differences in the prevalence and profile of problems also highlight the role of poor-quality buildings in driving rain-related problems in formal areas. Examining the situation within sites rather than between them shows that, with the exception of New Rest, the majority of respondents in each settlement experienced rain-related problems resulting from the way in which their dwelling was built or finished. Leaking roofs, walls, windows and doors were far more common in all five

settlements than other types of problems – although households in Luyoloville experienced high levels of all three. Vukuzenzele again showed fewer problems compared to the other sites, suggesting that dwellings built under the PHP programme may experience less flooding than those in highly standardised settlements developed by contractors.

Table 13: Summary of flooding dynamics by site cluster

Cluster	Site	% Experiencing problems	Average number of issues	Primary issues
Cluster 1	Kanana	19.6	1.9	<ul style="list-style-type: none"> • Seepage • Structural
	Luyoloville	26.0	1.8	<ul style="list-style-type: none"> • Run-off • Seepage • Structural
	New Rest	6.1	0.3	<ul style="list-style-type: none"> • Run-off
Cluster 2	Never-Never	20.4	2.1	<ul style="list-style-type: none"> • Run-off
	Phola Park	19.6	2.1	<ul style="list-style-type: none"> • Run-off
	Better Life	20.4	1.6	<ul style="list-style-type: none"> • Structural
Cluster 3	Kosovo	20.0	1.9	<ul style="list-style-type: none"> • Seepage
	Samora Machel	27.1	1.6	<ul style="list-style-type: none"> • Run-off • Structural
Cluster 4	Sweet Home	20.0	2.1	<ul style="list-style-type: none"> • Run-off
	Vukuzenzele	24.0	0.9	<ul style="list-style-type: none"> • Seepage

Wet, damp and mould: The impact of rain-related problems

As noted in Chapter 1, flooding on the Cape Flats seldom results in deaths, injuries or noteworthy infrastructural damage, but causes significant hardship for affected households. Research in informal settlements suggests that cold and damp conditions are responsible for illnesses, while poor sanitation and solid waste management in many areas means that water is polluted and causes other health problems. Flooding also incurs financial costs, due to sickness or where households need to spend money replacing or repairing their dwellings and possessions (see Ziervogel and Smit, 2009; Bahry, 2007). These costs have implications for households' immediate well-being.

They can also contribute to the accumulation of vulnerability over time, as households spend or lose scarce financial resources or become physically less able to withstand the effects of hazards due to deteriorating health (Bahry, 2007).

In this context, this section examines the impact of flooding on households' quality of life and resources. It compares the experiences of informal and formal households, and explores the extent to which the impacts documented in informal settlements extend to those living in subsidised housing. The section begins by examining the consequences of flooding, and how the impact varies across the different problem types. Drawing on households' income and expenditure data, as well as reported costs resulting from flooding, it then compares the financial burden incurred by households experiencing problems, and examines the implications of these costs.

Hazardous and costly: The impact of problems on quality of life and resources

The survey asked respondents to identify which of the types of flooding they reported had the greatest impact on their household's quality of life and which impacted most on their income. Quality of life is a broad concept linked to issues of household well-being and satisfaction that extend beyond the parameters of this research. It is conceptualised in this study in terms of how comfortable, pleasant or healthy the dwelling is to live in, and leaves aside larger questions about households' satisfaction with living in either informal or subsidised housing. Economic impact refers to the monetary costs rain-related problems incur, and how these impact on the financial resources available to households for day-to-day living, savings and other commitments.

The findings show that flooding impacts households, irrespective of where they live. Virtually all of those who experienced problems reported that they impacted on their household's quality of life and/or income, with households living in informal and formal areas reporting very similar levels of impact. In informal areas, 97% of respondents from households affected by flooding felt that it reduced their household's quality of life, while 94% reported that it impacted negatively on their income. The same proportion of respondents in formal areas (97%) felt that flooding

affected their quality of life, with 89% arguing that they reduced the financial resources available to the household.

Some problems had more of an impact than others. Figure 20 and 21 show the impact of different flood-types on informal and formal households respectively. They show the percentage of households reporting an impact by problem type, grouped as in the previous section. The blue bars show the proportion reporting that the problem impacted most on their quality of life, and the red bars show the proportion reporting that had the greatest impact financially.

The graphs indicate that seepage had the greatest impact on households in both informal and formal housing, despite being less common in subsidised settlements. In total, 61% of respondents in informal dwellings, and 59% of those in subsidised housing, reported that seepage had the greatest impact on their household's quality of life, while 59% of respondents in informal housing and 54% of those in formal housing felt that it impacted most on their household's income. A similar proportion of informal and formal households reported leaks and run-off, but leaks had a far greater impact on those in subsidised dwellings. As Figure 21 shows, half (50%) of respondents in the subsidised housing areas reported that structural problems impacted most on their household's quality of life, while 46% felt that they had the greatest economic impact. Only a small proportion reported that run-off impacted most on their quality of life or resources (both 4%).

Figure 20: The relative impact of problem-types on quality of life and income in informal housing

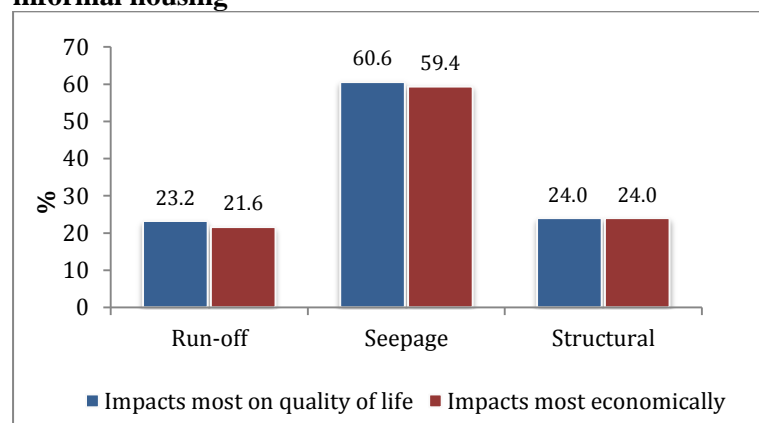
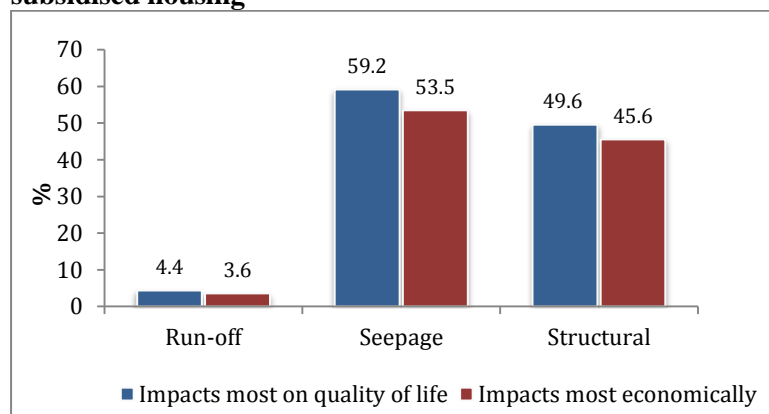


Figure 21: The relative impact of problem-types on quality of life and income in subsidised housing



Flooding impacts on households' quality of life by making houses cold and damp, and by encouraging the growth of mould. Respondents who reported an impact on their household's quality of life were asked to explain how these effects played out. The fieldworkers were asked not to read out possible options, but to allow interviewees to answer in their own words.³² Figure 22 and 23 show the types of impacts reported by informal and subsidised households respectively. The graphs show that households in informal settlements and subsidised housing experienced largely the same impacts. Those in informal settlements were most likely to report that their dwelling got cold and damp (21%), surfaces got mouldy (18%), and that furniture (17%), clothes (15%) and bedding (13%) got wet or damaged. Respondents in subsidised housing most often reported that surfaces became covered in mould (28%), the house became cold and damp (25%), clothing wet (15%), furniture damaged (14%) and bedding damp (11%). However, collapsing damage to furniture and wet clothing and bedding into a single category shows an important distinction between the experiences of households in informal and subsidised housing. Figure 22 shows that damage to dwellings' contents accounted for the largest share of the impact in informal households (45% compared to 39% for the conditions within dwellings), while Figure 23 shows that

³² The question was partly pre-coded, with the option of specifying additional answers; enumerators matched respondents' answers to the codes provided or wrote down answers that were not covered. These were allocated codes during the data capture. Respondents could identify more than one issue.

mouldy, cold and damp conditions were most common in subsidised households (53% compared to 39% for damage).³³

Figure 22: Rain-related issues impacting on informal households' quality of life

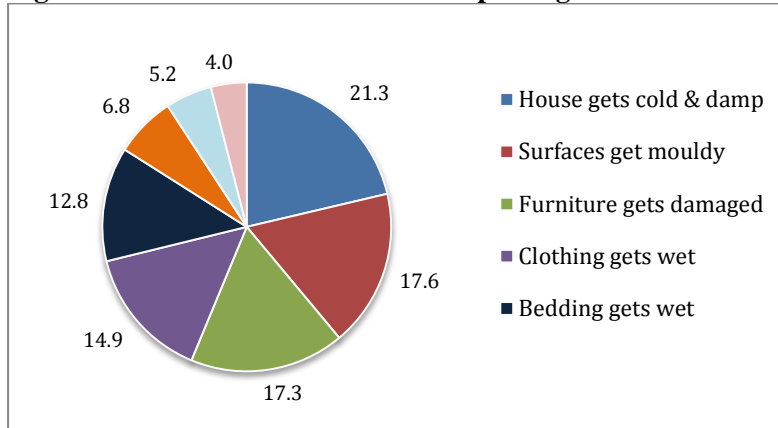
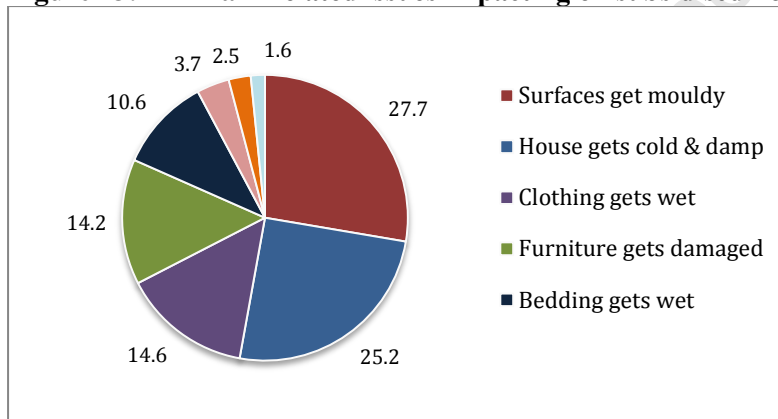


Figure 23: Rain-related issues impacting on subsidised households' quality of life

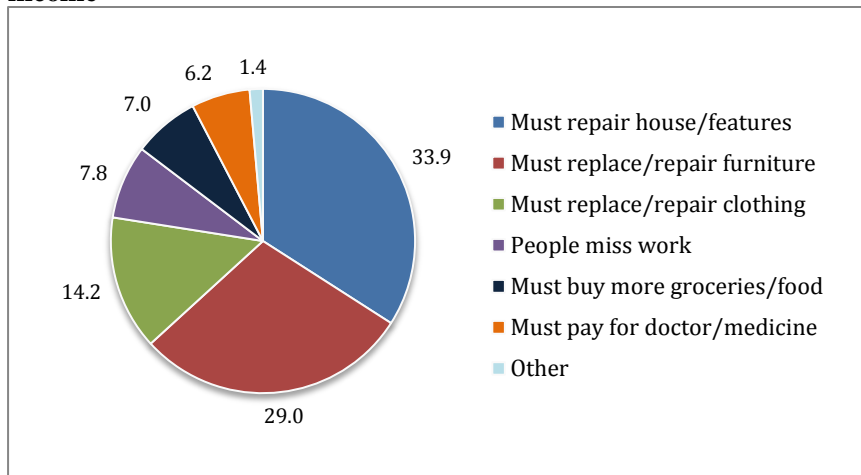


The economic impact was felt as a result of needing to make repairs or improvements, or to replace household contents. As with quality of life, respondents were asked to elaborate on how problems impacted on their household financially. Figure 24 shows the types of impacts reported by informal households, and Figure 25, by those in subsidised housing areas. The findings show that, as with quality of life, respondents

³³ The qualitative research suggests that dynamics within communities sometimes worsen the impact of problems on households' quality of life. Respondents in both informal and formal areas noted, for instance, that people are often reluctant to take wet belongings outside to dry for fear of them being stolen - although respondents in Vukuzenzele reported that people often helped one another by keeping an eye on each other's possessions, or by providing a dry place to store property. The result is that once items get wet, it is frequently difficult to dry them out properly, and they remain damp for some time.

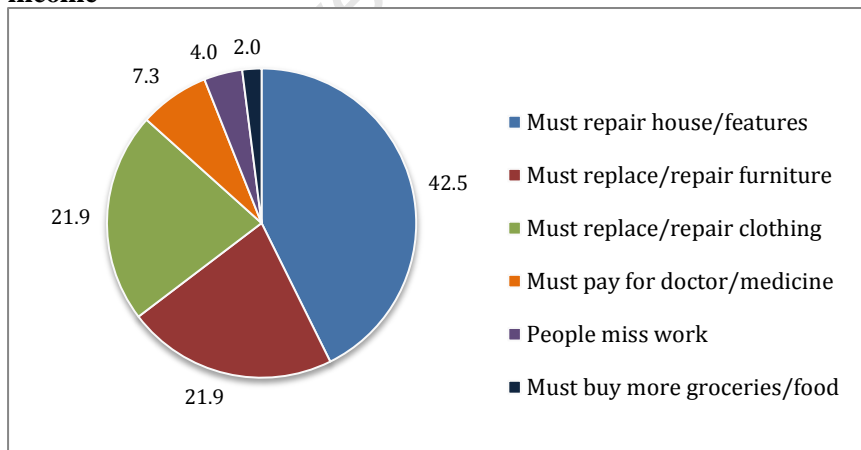
in formal and informal housing experienced the same types of economic impacts. These included needing to repair or improve their dwelling to prevent future damage (34% and 43% for informal and formal households, respectively), and replacing or repairing furniture (29% and 22%) or clothes (14% and 22%). Households living in subsidised housing, however, were more likely than those in informal settlements to spend money on mending or improving their house relative to other costs.

Figure 24: Sources of expenditure impacting negatively on informal households' income*



* Values less than 1% removed

Figure 25: Sources of expenditure impacting negatively on formal households' income *



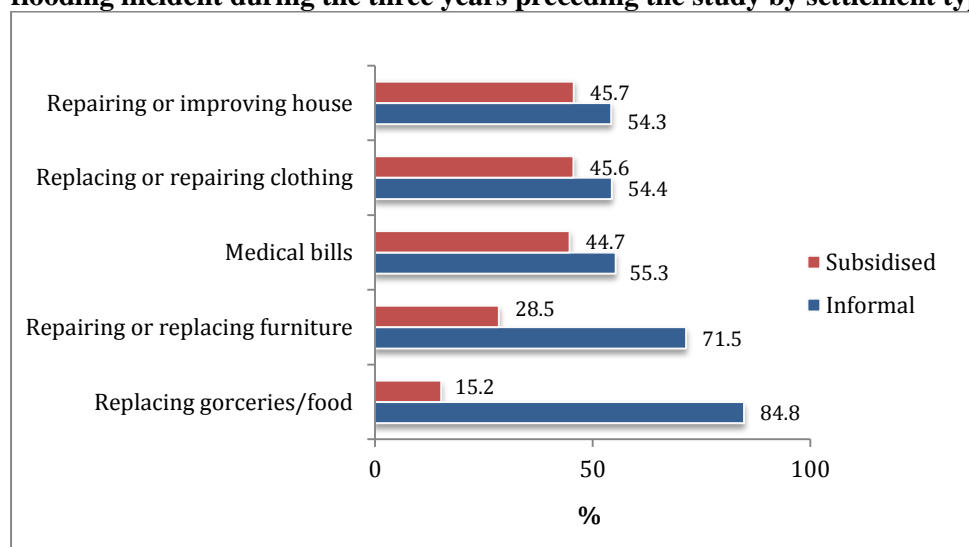
* Values less than 1% removed

These findings on the impact of flooding show that not only do households living in subsidised housing experience rain-related problems, they have a significant impact, at levels comparable to informal settlements. The differences in how these impacts play out in the two housing types suggest a level of intractability to the concerns in subsidised areas. Leaks in informal housing may result in damage and create cold and wet conditions, for instance, but dwellings and their contents are likely to dry out as rain subsides and during the dry summer months. Damp in walls and mould are much harder to eliminate, and once established may persist throughout the year. This may explain why leaks have a far greater impact on households living in subsidised housing compared to those in informal settlements. The findings also suggest that although leaks appear trivial compared to the potential inundation caused by seepage and run-off, they impact significantly on affected households' financial resources.

The higher financial burden on households in subsidised dwellings

In an effort to understand the extent and depth of the economic impact, respondents who reported flooding were asked whether their household had needed to spend money as a direct result of the most serious incident. This included expenditure on replacing or repairing furniture or clothes, replacing groceries or food, repairing or improving the house or on medical bills. Respondents were asked to estimate the amount spent on all or any of these expenses. The results show that the majority of households in the informal areas (62%) had spent money. Respondents in the formal areas were less likely to have incurred financial costs, but two out of five (38%) had. Figure 26 shows the nature of the spending. The red bars show expenditure by households in subsidised housing, while the blue bars denote expenses paid by households in informal settlements. The graph shows that households in the informal settlements were most likely to spend money on replacing food or groceries, or replacing or repairing furniture. Spending in formal households was spread evenly between repairing or improving the dwelling, repairing or replacing clothes and medical expenses.

Figure 26: Spending due to costs incurred as a direct result of the most serious flooding incident during the three years preceding the study by settlement type

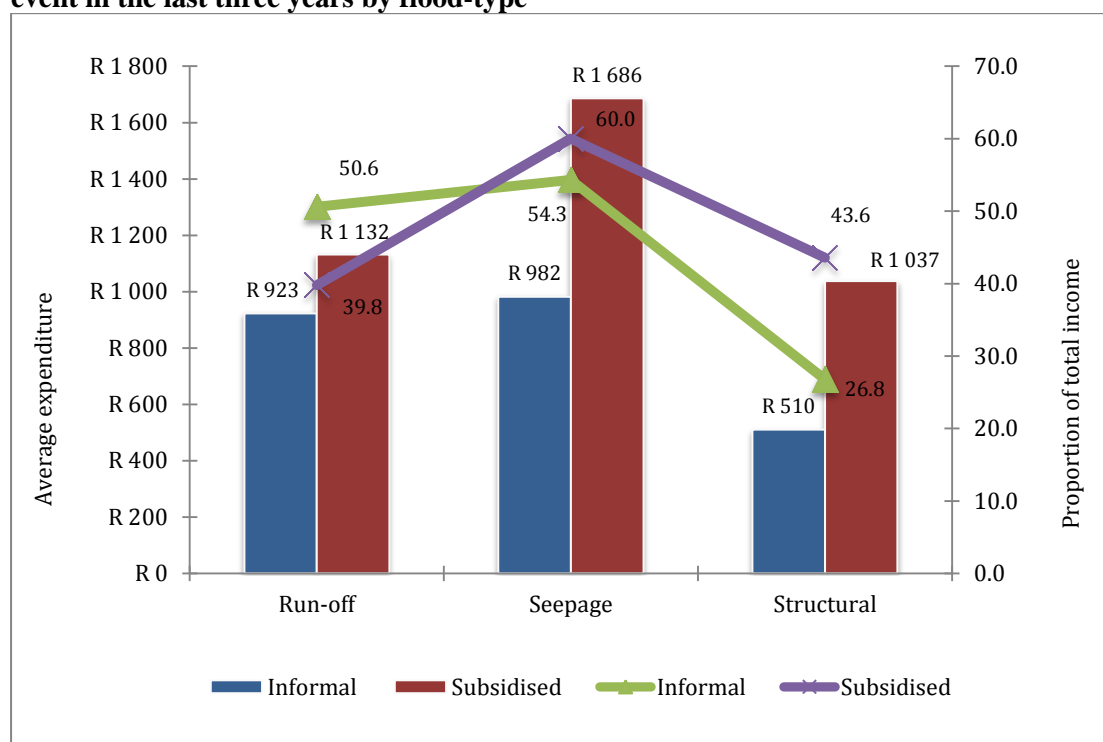


These costs were often substantial, particularly for households in subsidised housing. Figure 27 shows the average amount spent by informal and formal households by problem-type, and these costs in proportion to households' total monthly income. The bars show the average household expenditure by the type of flooding identified as having the greatest financial impact. The two-toned bars show the results for informal households, and the darker bars the findings for formal households. The lines show the average amount spent as a proportion of households' average monthly income. The dotted line shows the data for the informal settlements, and the solid line that for the formal areas. The results show that informal households spent an average of almost R 1 000 (approximately US\$ 110) as a result of seepage and run-off-related damage, and just over R 500 (US\$ 56) as a result of leaks. Those in formal dwellings spent an average of R 1 686 (US\$ 190) on addressing seepage and just over R 1 000 (US\$ 110) due to leaks. In formal households, this amounted to as much as 60% of their monthly income in the case of seepage and 44% in the case of leaks. In contrast, those in informal housing spent 54% and 27% of their monthly income due to seepage and leaks respectively.

This higher expenditure by households in subsidised dwellings is likely to reflect both higher incomes and the higher cost of damage. As discussed in Chapter 5, disposable income per capita was slightly higher in subsidised housing areas. Households in

formal areas had an average disposable monthly income of R 360 (US\$ 40) per capita compared to R 299 (US\$ 33) in households living in informal settlements, which may have allowed them to spend more. Higher spending is also likely to reflect greater asset values and the higher cost of addressing problems relative to informal dwellings. As discussed further below, re-plastering a wall, for instance, costs substantially more than repairing or replacing a piece of corrugated iron which, according to focus group participants in Kosovo, costs between R 30 – R 50 (US\$ 3 – US\$ 6) per sheet

Figure 27: Average expenditure and proportion of income spent on the most serious event in the last three years by flood-type



Notably, although relatively few households in subsidised housing experienced damage as a result of run-off, those households that had spent an average of R 1 132, and as much as 40% of their income – only fractionally less than that spent as a result of leaks. This may reflect the type of damage. Although infrequent, water flowing into a dwelling as a result of run-off may have a major impact and is likely to require a more costly ‘fix’, such as raising the level of the floor slab, or building a step around the house.

Households spent the most on repairing or replacing furniture and fixing or improving their dwelling. Table 14 shows the average amount of money spent by households on replacing or repairing furniture or clothes; replacing spoiled groceries or food; repairing the dwelling; implementing measures to prevent future problems; and on medical bills.³⁴ Households in informal settlements were most likely to spend money on replacing food or groceries (see Figure 26, above), but both those living in informal and subsidised housing spent the most on replacing or repairing damaged furniture. Formal and informal households spent an average of R 1 364 (US\$ 155) and R 868 (US\$ 100) respectively. Next highest was expenditure on repairing or improving the dwelling, with households spending an average of R 1 017 (US\$ 115) and R 599 (US\$ 70) in subsidised housing and informal areas respectively. Households also often spent income on replacing groceries, and only slightly further behind, on repairing or replacing clothing. Relatively few reported needing to spend money on medical attention (15% in formal areas and 11% in informal areas respectively), but those that did, spent upwards of R 250 (US\$ 30), suggesting serious health impacts, such as respiratory infections and asthma.

Table 14: Spending patterns in rainfall-affected households

Item	Household lives in a formal or informal dwelling	N	Average amount spent	Std. Deviation	Std. Error
Replacing or repairing furniture	Informal	101	R 867.82	R 1 158.46	R 115.27
	Formal	38	R 1 364.47	R 1 520.04	R 246.58
Replacing or repairing clothing	Informal	54	R 385.19	R 263.85	R 35.91
	Formal	47	R 521.26	R 603.13	R 87.98
Replacing groceries	Informal	26	R 421.92	R 239.03	R 46.88
	Formal	5	R 880.00	R 661.06	R 295.63
Repairing or improving the house	Informal	96	R 598.65	R 491.51	R 50.16
	Formal	79	R 1 017.32	R 993.07	R 111.73
Medical bills	Informal	22	R 255.82	R 228.55	R 48.73
	Formal	17	R 387.94	R 442.67	R 107.36

³⁴ Standard deviation measures the dispersion of a set of data from its mean (average). The more spread apart the data, the higher the deviation, and the more variation there is in the data. Standard error is a statistical term that measures the accuracy with which a sample represents a population. The smaller the standard error, the more representative the sample will be of the population examined. Standard error is linked to sample size; the larger the sample, the lower the standard error. The standard deviations and errors shown in the table suggest that there is a fair amount of variation within the sample, but that results can be confidently extrapolated to the population of flood-affected households in the areas in question.

As noted already, the larger amount spent by formal households on repairing or improving their dwellings is likely to reflect the higher costs of intervention. It may also indicate more limited access to assistance. This is illustrated by data on households' efforts to mitigate flooding. This information on efforts to mitigate rain-related problems was gathered from all respondents, irrespective of whether or not they reported rain-related problems, as the absence of issues could reflect successful mitigation. Provision was made for households to report multiple measures.

The findings show that virtually all the households in informal settlements (93%) undertook measures to mitigate flooding. These most often involved diverting or controlling water, or raising the level of the floor in some way. Table 15 shows the types of interventions identified. Households were most likely (37%) to have dug channels or barriers to drain or steer water away from the dwelling, or to have raised the floor of the dwelling or yard (28%) using sand, rocks, wooden pallets, or a combination of materials (Figure 28b). Less common measures included putting plastic over the roof to prevent water from leaking through, building barriers to prevent water from entering the dwelling (see Figure 28d), putting down carpeting to absorb water, or putting down a concrete floor slab (Figure 28a), with households often employing a combination of measures, as illustrated in Figure 28c.

Table 15: Measures taken by those in informal dwellings to prevent or address rain-related problems*

Measures	N	%
Dug channels to drain water away from house	187	36.6
Raised the level of the floor	141	27.6
Put plastic over the roof	89	17.4
Built barriers to prevent water coming in	43	8.4
Put down carpeting to absorb water	20	3.9
Put down a concrete floor slab	20	3.9
Other	11	2.2
Total	511	100

* More than one answer possible per respondent

Figure 28: Examples of mitigation measures adopted in informal settlements



Figure 28a: Concrete floor and step (Kosovo, November, 2010)

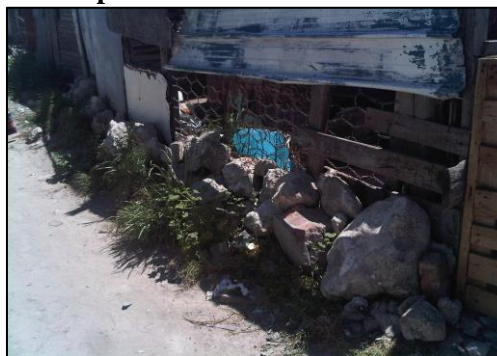


Figure 28b: Raised floor using rocks and rubble (Sweet Home, November, 2010)



Figure 28c: Raised floor with wooden pallets and carpeting to absorb water (Khayelitsha, June 2006)



Figure 28d: Planks used to create a barrier to prevent water reaching dwelling (Sweet Home, November, 2010)

These were often ‘free’ measures. The qualitative research suggests that sand and rubble were often sourced from around settlements or scavenged from builders’ dumpsites. Households also received and depended heavily on sand from the City authorities, which provide high-risk communities with sand in the run-up to winter. Putting plastic sheeting over the roof also often incurred nominal costs, as plastic too was provided both wittingly and unwittingly by the City, either in the form of plastic specifically distributed by the DRMC during winter, or in the form of the refuse bags distributed under the auspices of the Solid Waste Management Department.

However, these ‘free’ fixes have their disadvantages. Focus group participants in Kanana, for instance, reported that residents relied heavily on sand from dumps and from around the settlement (Figure 29), but noted that this was not ‘proper’ sand. They argued that it had a much finer grain than that provided by disaster management,

was more prone to subsidence and was less effective in raising floors. Participants in Kanana, and the other informal settlements, argued that putting down a concrete floor was by far the most effective way of addressing flooding, much more so than raising the floor with sand or putting down carpeting to absorb water, but that the greater cost was often prohibitive.

Figure 29: Sand collection site, Kanana informal settlement (November, 2010)



Formal households, however, invariably had to spend money. As Table 16 shows, many measures involved potentially substantial capital outlays. In addition to painting walls with paint (38%) or Crestone (13%), a product similar to whitewash, respondents reported adding a step to the front of the house (17%) (see Figure 30a), laying or adding cement to an existing floor slab (9%), and plastering or re-plastering walls (9%) (see Figure 30b). The costs of intervention are reflected in the lower proportion of formal households undertaking mitigation measures. Only one third (36%) of households had taken measures to prevent or address leaks, seepage or run-off. This was partly because fewer of them experienced problems, but was also due the expense, with almost one quarter (24%) reporting that they did not have the money to do anything. Several focus group respondents flagged cost as a deterrent to mitigation. As a respondent from Better Life observed: “these things cost money; mostly we just fix what is broken”. People repaired or improved their homes if and when they could, or when it became absolutely necessary.

Data on the cost of interventions in formal areas illustrates the scale of potential expenditure. When asked how much money they had spent on measures to address or prevent leaks, seepage and run-off, most respondents in subsidised housing areas

reported that their household had spent R 1 000 (US\$ 110) or less (69%), with an average spend of R 816 (US\$ 92). However, just under one sixth of households (16%) spent between R 1 001 and R 2 000 (US\$ 226), with a minority (7%) spending more. Given that the average monthly disposable income after expenses and food was only R 1 276 (US\$ 144), this spending represents a considerable outlay for affected households. Moreover, only half of the sample (52%) put any money towards savings each month – virtually all of whom saved less than R 100 (US\$ 11) per month – suggesting that the money spent on trying to mitigate rain-related problems often absorbs the income available for other expenditure.

The qualitative research suggests that the adoption of measures was not always beneficial. Many respondents in Better Life, for instance, reported that their households had painted their walls with Crestone or regular paint. This makes walls look better in the short term, but neither intervention addresses the underlying weaknesses that result in leaks. Although many respondents reported that such measures were effective, the use of Crestone, in particular, might in fact exacerbate problems, as it is hydroscopic and attracts moisture from the atmosphere (Wust, personal communication, November 2010). A small number of households (7%) used anti-fungal paint, which would go some way towards slowing the growth of mould but, again, the underlying flaws remain. This suggests that with limited building expertise, households sometimes spend resources on ineffective measures that are unlikely to reduce risk.

These findings indicate that households sometimes lack the knowledge to protect their homes against flooding. This issue was not explored in depth in this study, but the qualitative research suggests that households in subsidised housing areas may be less equipped to address flooding than their counterparts living in informal dwellings. Home owners in Better Life, for instance, noted that dealing with flooding in informal settlements was easier than in subsidised housing, as people knew how to weatherproof or repair a shack, but not a brick and mortar dwelling. Group participants noted that, while beneficiaries sometimes struggle to repair and maintain formal dwellings, “people know how to make a shack safe”. This suggests that insufficient knowledge about how to address flooding in formal dwellings might contribute to risk in subsidised housing areas.

Table 16: Measures taken by those in formal dwellings to prevent or address rain-related problems*

Measures	N	%
Painted the internal walls	46	38.4
Added a step to the front of the house	20	16.7
Use Crestestone on the internal walls	15	12.5
Put down concrete or added more concrete to the floor slab	11	9.2
Dug channels to drain water away	11	9.2
Plastered or re-plastered walls	11	9.2
Raised the level of the yard with sand	3	2.5
Covered the roof with tar	2	1.7
Put in a new roof or ceiling	1	0.8
Total	120	100

* More than one answer possible per respondent

Figure 30: Examples of mitigation measures and/or repairs adopted by households in subsidised housing areas

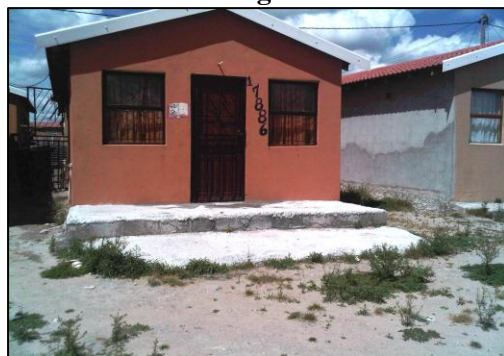


Figure 30a: Dwelling with step added to house (Better Life, October, 2010)



Figure 30b: Dwelling with a re-plastered wall (Better Life, October, 2010)

The next section examines how these costs impact on households in the short and medium term. These implications provide an indication of how vulnerability may accumulate over time. Where households have more resources available to them, or can dip into savings, for example, they might manage to carry these costs better than households with fewer resources, reducing their overall impact. To this end, the next section explores where households obtained the money to cover the costs of repairing or replacing household items, fixing or improving their dwellings or taking measures to address flooding.

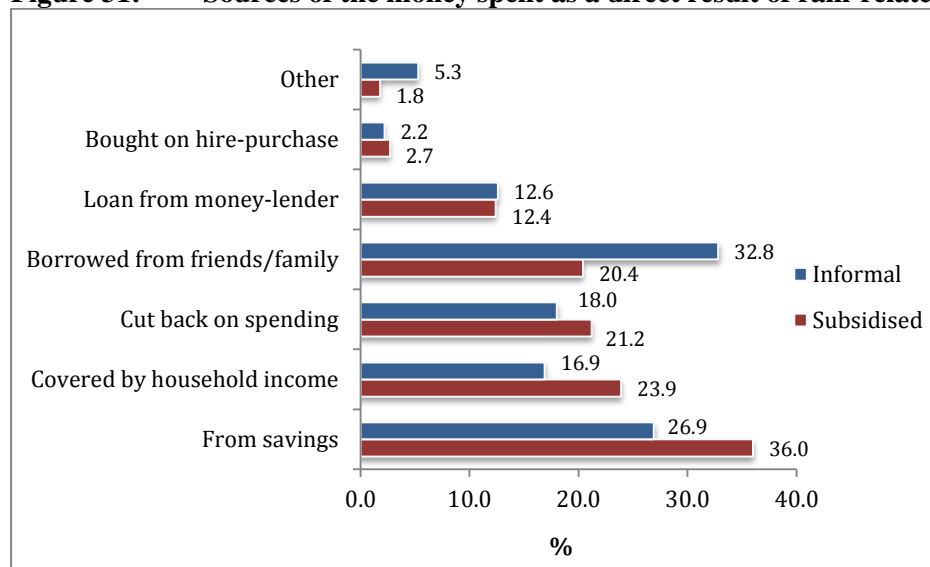
Cutbacks and debt: Covering the costs of flooding

The findings suggest that the financial costs incurred as a result of flooding have a negative impact on household well-being. Figure 31 shows where households obtained the money to pay for repairing or replacing items, fixing their dwelling or medical expenses. Respondents were not prompted and were asked to answer in their own words. The graph shows that some households earned sufficient income to absorb the costs without them impacting negatively on their available resources. Some were also able to draw on savings, including community-based saving mechanisms such as stokvels.³⁵ Many, however, incurred some kind of debt, needing to borrow money from family, friends or a money-lender. Households living in subsidised housing were often in a better position to draw on savings or on normal income, but they were also more likely to cut back on the amount spent on food and groceries, bills and other items (21% as opposed to 18% in informal households). They were less likely to borrow money from friends or family (20% as opposed to 33% in informal areas) and were as likely to borrow money from a money-lender (12% compared to 13% for formal and informal households respectively).

These findings highlight the negative and potentially long-term implications of rain-related problems for households in both subsidised and informal housing. Depending on the severity and duration, cutting back on essentials has the potential to undermine households' immediate well-being in a range of ways, from nutritional and health impacts to the suspension of municipal services such as electricity and water. Getting into debt, in particular, may also have long-term implications. Borrowing money from money-lenders, especially, may consume household resources for months or even years after an event, as they often charge very high interest rates on loans. This could leave households with less income to respond to or address flooding in the future, and potentially physically less able to withstand and cope with its impacts.

³⁵ Stokvels are community-based rotating savings and credit societies. They are common in poorer communities with limited access to the formal banking sector. Members regularly contribute an agreed amount from which they receive a lump sum payment on a rotating schedule.

Figure 31: Sources of the money spent as a direct result of rain-related problems



In summary, the findings show that seepage, leaks and run-off impact on households in both informal settlements and subsidised housing. Problems reduce households' quality of life by wetting and damaging furniture, clothing and bedding, and by creating wet and mouldy conditions. Damp and mould are particular concerns in subsidised housing areas, and may cause health problems such as respiratory infections, asthma and other more minor illnesses such as allergies, colds and influenza. The findings also show that households incur substantial financial costs, particularly in subsidised housing areas. Households living in subsidised housing often have more resources available to them than those in informal settlements, but addressing and mitigating leaks, seepage and run-off is also more costly for formal households, balancing out any financial advantages. Households in subsidised housing areas often need to spend more as a proportion of their income than those in informal settlements. Data on where households obtain the money to cover these costs suggests that they often consume the resources available for necessities and other expenditure, possibly reducing household well-being in the short-term. The findings also suggest that costs may increase the financial burden on households in the longer term, potentially leading to the accumulation of vulnerability over time.

‘Minor’ problems, major impact: Extending the parameters of flood-risk in Cape Town

These findings suggest that, although rain-related problems in subsidised housing areas appear relatively minor, they have markedly negative implications. Damp conditions and the growth of mould seem banal compared to the chronic seepage and varying degrees of inundation seen in informal settlements, but the results show that they can have a profound effect on households’ quality of life. As discussed above, they may also consume household resources in the short and medium term.

The qualitative research provides insight into the potential severity of these impacts. It indicates that, in extreme cases, the growth of mould made some dwellings uninhabitable. This was particularly the case in Better Life, where houses often showed substantial mould growth. Some dwellings were more affected than others, but in the worst cases walls were covered with a thick layer of black mould and respondents reported suffering from allergies, asthma and respiratory problems (see Figure 32a-c). In a handful of the worst affected dwellings, the conditions inside had deteriorated to the point that homeowners had moved out of their dwelling into backyard shacks on their property. This was often costly. Focus group participants reported that it cost approximately R 3 000 to purchase and erect a prefabricated corrugated iron shack. The situation in most dwellings was far less severe, but the findings nevertheless underscore the potential seriousness of ostensibly ‘minor’ rain-related problems.

These findings suggest a need for a broader conceptualisation of risk in Cape Town. Local discussions on flooding focus on issues such as seepage, ponding in poorly drained areas, and the expansion of settlements into wetlands and detention ponds (for instance, Drivdal, 2011 a-b; Armitage et al, 2010; Ziervogel and Smit, 2009; Bouchard et al, 2007), but it is leaks and the resulting damp and mould that are the greatest challenges in subsidised housing areas. The research by DiMP (2003) and Benjamin (2008) draws attention to leaks as a source of flooding, but my findings suggest that the leaks themselves are less important than the damp and mould. Leaks

allow rain into dwellings, but it is damp and mould that are the primary sources of harm, suggesting that these need to be included in discussions on flooding.

Figure 32: Illustrations of mould on internal walls in Better Life (October, 2010)

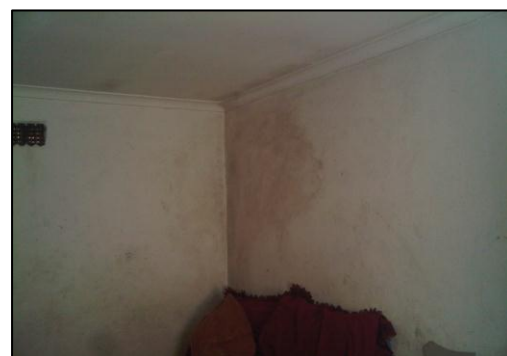


a)



b)

Figure 32a, b: Severe mould on interior walls



c)

Figure 32c, Less severe mould, illustrating differences between 'clean' and mouldy walls.

These findings suggest a need to rethink how hazard and risk are conceptualised more broadly. The literature on urban flooding has served to extend how the hazard is understood, but as discussed in Chapter 2, it is still conceptualised in terms of weather and too much water. For instance, compromised or poorly maintained drainage infrastructure may overflow during heavy rain or fail to drain water away from settlements, but the causality continues to run from heavy rain, through mediating factors to the flow of water into areas that should be dry. This is not the dynamic in subsidised housing areas. As discussed further in the next chapter, flooding in subsidised settlements is not about excess water, but instead a failure to keep rain out of dwellings. Rainfall does not result in inundation, but in damp conditions and the growth of mould, which are the primary sources of endangerment. The timescale involved is also longer. Flooding in the conventional or urban sense may last hours,

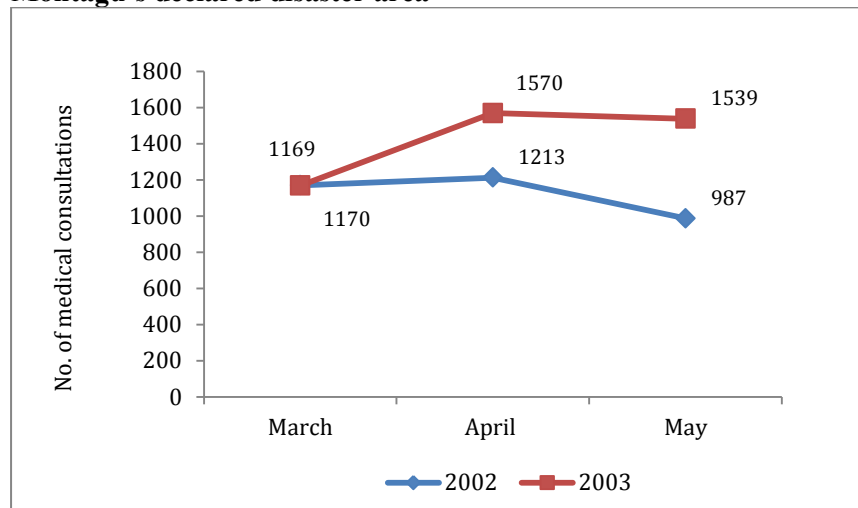
days, or in the case of seepage weeks or months, but the problems in subsidised housing areas persist well beyond single storms or even multiple events. Seepage may submerge dwelling floors for lengthy periods, but damp and mould are long-term challenges. They are difficult to eradicate without making fundamental repairs to roofs and walls, and may remain problems throughout the year, progressively worsening with each winter. There may also be a lag between cause and consequence, with the effects of flooding being felt several days, weeks or even months after the triggering event.

While not explored in depth in this study, DiMP's research following the Montagu flood in late March 2003 (DiMP, 2003) illustrates this lag. Figure 33 presents data collected from local clinics in the area affected by flooding for March, April and May 2002 and 2003. It compares the number of children less than five years old treated for lower respiratory infections at local clinics. The solid black line shows that in March 2003 the number of consultations was almost identical to that of the previous year, but was far higher in April and May 2003 (represented by the grey, dashed line). The number of cases reported was 29% higher in April 2003 than in April 2002, and 60% higher in May 2003, than the preceding year. Overall, the number of lower respiratory infections was 86% higher in 2003 than in 2002, suggesting far greater levels of illness following the flood. This increase was attributed to the damp conditions, with affected households reporting wet bedding and household items and damp walls. Most pertinent to the current study, the increase in infections in April and May 2003 compared to 2002 suggests that, although the rains impacted on children's health, these outcomes were not immediate; it took some time before the full effects of the flooding were felt.

The differences in risk profile between settlements also points to the role of build-quality in driving risk. The findings suggest that it is poorly constructed buildings that serve to perpetuate risk in subsidised housing. This hypothesis is tested more thoroughly in the next chapter, but the descriptive and qualitative analyses suggest that poorly built dwellings make households in subsidised housing vulnerable to rain-related problems. The findings also suggest that poor-quality buildings serve to amplify risk. While there needs to be a large amount and/or ongoing rain before seepage or run-off become problems, even low to moderate levels of rainfall can

penetrate cracks and poorly laid roofs, suggesting that substandard buildings serve to extend the parameters of the hazard; it is not just heavy rainfall and severe weather that result in problems for poor households, but also low levels of rainfall.

Figure 33: Trends in medical consultations for respiratory illnesses (children < 5) in Montagu’s declared disaster area



Source: DiMP, 2003

New house, new risk: Rethinking assumptions about flood-risk in subsidised housing

In summary, the findings refute assumptions about the lower levels of flood-risk in subsidised housing areas, and suggest the need for more care in how we conceptualise risk. The authorities, researchers and communities view the provision of housing as the solution to flooding, but the findings show that it remains a hazard in subsidised housing areas, albeit often in new forms, such as leaks through poorly laid roofs or badly plastered walls. They suggest an important gap in the conceptualisation of risk in Cape Town. The findings show that by assuming that only informal settlements experience flooding, the authorities and research community fail to see the risk that exists in subsidised housing areas. They suggest that prevailing constructions of risk do not capture the full range of experience in urban areas. The frequently marked differences between formal settlements also highlight the dangers of oversimplifying how risk is conceptualised. They suggest that making broad assumptions about who is vulnerable, and to what they are vulnerable, obscures the complex, often highly

individualised dynamics driving vulnerability. In both cases, this prevents a comprehensive and holistic understanding of risk.

The problems in subsidised housing settlements appear rooted in the built environment. The literature often focuses on the political and socio-economic drivers of risk, but the findings suggest that the built environment is also important. This is explored in greater detail in the next chapter, but the differences between sites located in similar physical and social environments suggest that the built environment, and the quality of dwellings in particular, may play a key role in driving risk in Cape Town. As discussed in the next chapter, these quality issues are undoubtedly linked to macro-political and socio-economic dynamics. These include the inequities that are the legacy of Apartheid planning, and more recently, inadequate monitoring and oversight, the pressure on government and contractors to deliver and the limited resources available to the housing programme, as well as beneficiaries' capacity to hold contractors accountable for substandard work. However, the findings suggest that the built environment plays an immediate and central role in making households vulnerable to flooding. Although not explored deeply in this thesis, the expense of mitigating problems and possibly knowledge may also prevent poor households from taking steps to reduce their risk.

The findings also show that households in both informal and subsidised housing are negatively affected by flooding. Rain-related problems impact on the quality of life and resources of both informal and formal households, although these impacts play out slightly differently. Wet belongings and rain-related damage have the greatest impact on the health and well-being of informal households, while damp and mouldy conditions affect most of those in subsidised housing. These seemingly minor problems incur substantial costs. The findings show that although households living in subsidised areas often have more resources available to them than those in informal settlements, they also need to spend more as a result of flooding.

These findings suggest that rather than addressing flood-risk, the poor quality of subsidised housing serves to transform and transfer risk as people move into formal housing. This undermines fundamentally the developmental objectives of the housing programme. Instead of uplifting households, the frequently poor quality of dwellings

serves to perpetuate flooding. This reduces well-being, consumes households' resources and potentially increases vulnerability with each passing winter.

They also point to the need for a broader approach to understanding both the nature of flood-risk in Cape Town and rainfall as a hazard. Contrary to assumptions about flooding in the local and international literature, the results suggest that it is not excess water that is a concern for households in subsidised housing areas, but instead poorly constructed dwellings that allow in water. This subtle shift in emphasis has important implications for how we understand the hazard, as even low to moderate levels of rain pose a threat to households. From this perspective, the conventional hazard – rainfall or severe weather – may trigger problems, but the levels of rainfall are far less important than issues such as the physical resistance of buildings. Moreover, the nature of the hazard also shifts. The issue is not rain-related inundation, but damp conditions that encourage the growth of mould – the primary destructive agents. Damp and mould may affect dwellings well beyond the lifespan of storms, severe weather or even rainy seasons, requiring again a shift in how we conceptualise the problem.

The next chapter explores in more detail the drivers of risk. It expands on the issues identified in this chapter, particularly the role of poorly built housing in driving vulnerability. The findings in this chapter make a strong case for the role of the built environment in driving risk, but the next chapter tests statistically the relative influence of housing quality compared to other factors, such as housing features, location and households' socio-economic characteristics.

CHAPTER 7

Quality and Design: The Factors Driving Flooding in Subsidised Housing

Introduction

As explored in Chapter 2, thinking on the drivers of risk has shifted from a hazard-focused perspective to more society-oriented approach. This emphasises the socio-economic and political inequities that leave people vulnerable to the effects of hazards, although some continue to focus on the geophysical or hydrological aspects of flood-risk. Cape Town's DRMC, for instance, conceptualises vulnerability primarily in terms of exposure, and focuses on geographical sources of vulnerability such as the location of dwellings in low-lying areas, within floodplains or close to watercourses, or in seasonal wetlands and stormwater detention ponds (City of Cape Town, 2009, cited in Ziervogel and Smit, 2009). However, research and theory increasingly focus on the physical, economic, social, environmental and institutional characteristics that drive vulnerability (see Wisner et al, 2004; Pelling, 2003; Heijmans, 2001; Hewitt, 1997; Blaikie et al, 1994).

This chapter examines the drivers of risk in the five formal sites investigated in the research. While Chapter 6 interrogated assumptions in the local literature about who is considered vulnerable and to what they are vulnerable, this chapter focuses on the factors making households vulnerable. I use binary logistic regression analysis to examine how different factors influence the likelihood of households experiencing flooding. In keeping with prevailing discussions on risk, I take a multi-dimensional approach. I explore the role of architectural, physical and socio-economic attributes in determining why some households experience flooding and others do not. I use spatial data to examine the geographical components. Drawing on the findings in Chapter 6,

which showed considerable variation in the types and levels of flooding between settlements, the spatial analysis also examines patterns of risk within settlements. Both analyses draw on the qualitative research to frame and explain findings, particularly with respect to respondents' perceptions of the drivers of risk.

I focus particularly on how architectural factors and the quality of housing influences risk. The previous chapter built a strong case for the role of design and build-quality in driving flooding in subsidised housing areas, but it is impossible to tell from the descriptive analysis alone whether these variables are important, or whether there are other factors influencing the findings. The results on build-quality could, for instance, mask or be influenced by other less visible factors, such as dwelling features or the resources available to households. The statistical analysis aims to tease out these relationships and determine the relative role of building-related factors compared to other attributes.

I focus on dwellings for two reasons. The first concerns prevailing assumptions about the role of housing in addressing flood risk. Given the emphasis on housing as a vehicle for development and risk reduction, it is important to explore if housing does solve flood-risk. The second is more theoretical. With the exception of discussions on seismic risk and earthquake protection, there is little discourse on the contribution of the built environment to risk. As explored in Chapter 2, many commentators recognise that weak buildings can increase vulnerability (for instance, Mileti and Gailus, 2005; Cardona 2004; 2003; Briguglio, 2003; Cutter et al, 2003; Pelling, 2003), but the focus tends to be on the macro-economic and political processes that encourage the construction of poor-quality buildings rather than the structures themselves (see Wisner et al, 2004; Pelling, 2003; Heijmans, 2001; Hewitt, 1997; Blaikie et al, 1994). Where aspects of the built environment are examined, the focus is often on infrastructure and lifelines (see Mileti and Gailus, 2005; Cutter et al, 2003; Mileti, 1999), or on generic categories such as 'slum' dwellings, poorly maintained buildings or rental housing (for instance, Wisner et al, 2004; Pelling, 2003; Blaikie et al, 1994). Few analyses explore precisely what it is about dwellings or settlements that increases vulnerability. The findings presented in Chapter 6 suggest that this represents a gap in discussions on flood-risk in Cape Town, and risk more generally –

a gap that prevents a comprehensive understanding of urban risk locally and in parallel contexts elsewhere.

I show that vulnerability in Cape Town has a crucial built environment component. The findings illustrate that rather than addressing flood-risk, the poor design and quality of dwellings serves to perpetuate and amplify flood-risk. This result is particularly important in the context of subsidised housing, as it not only fundamentally challenges assumptions about housing as a solution to risk, but also suggests that flooding undermines the developmental objectives of the housing programme. My research also suggests that vulnerability and risk accumulate and manifest in highly idiosyncratic ways, and are embedded in the design and construction of settlements and individual dwellings. Drawing on these findings, I argue that there needs to be more emphasis on the role of the built environment in driving flood-risk in Cape Town. I also argue that risk accumulates and manifests at the micro-level, and needs to be conceptualised more precisely if it is to capture the experiences of households in subsidised housing areas.

The chapter begins by briefly reviewing my analytical approach and the variables used in the statistical analysis. It goes on to frame and examine the factors influencing households' likelihood of experiencing run-off and seepage, and the relative influence of architectural, socio-economic and other variables compared to geographical characteristics, particularly elevation and proximity to water bodies or drainage features. The chapter then examines the factors influencing the experience of structure-related problems. Finally, I explore the macro-level factors that may help to shape realised risk in subsidised housing areas.

Testing influences: Recap of the analytical approach and variables

The statistical analysis examines the influence of four broad types of factors. As detailed in Chapter 4, these include the location of dwellings, the physical-architectural characteristics of dwellings, households' socio-economic characteristics, and other features, such as the amount of time taken to build dwellings, and whether

households adopt measures to mitigate rain-related problems. Working on the assumption that particular types of flooding are likely to be influenced by some factors more than others, these variables were run against the three categories of rain-related problems used in the previous chapter.

Table 17 summarises the indicators included in the statistical analysis. As discussed in Chapter 4, the survey questionnaire drew heavily on good practice guidelines used by FEDUP and other stakeholders involved in the PHP and the National Housing Code, although the absence of technical detail in the latter made it difficult to use as a benchmark. Relevant examples of good practices include that:

- walls should be plastered;
- there should be sufficient space between dwellings to allow for a 60 cm concrete apron around the building;
- roofs should overhang the exterior wall by at least 60 cm;
- floor slabs should be at least 15 to 20 cm above the lowest curb on the property; and,
- roofs should be sloped.

Drawing on information collected during the qualitative research, the survey also included questions on whether dwellings had ceilings and cavity walls, as well as the primary material used to build walls and the space between dwellings. Given that Cape Town lies in the SCCPA, government regulations require that dwellings have ceilings, while good practice identifies the need for cavity walls. As discussed earlier, focus group discussions in Samora Machel suggested that dwellings with vibracrete walls were more prone to problems. Participants in Vukuzenzele indicated that the space between dwellings was also important, with respondents reporting that where dwellings are positioned too close together rainwater runs off these roofs and into neighbouring properties.

Wherever possible, these benchmarks were used in the statistical analysis, but this was not always feasible. As discussed in Chapter 5, many dwellings simply did not meet the required standards or suggested guidelines. None of the dwellings had cavity

walls for instance. Similarly, the majority of dwellings (75%) had roofs that extended less than the recommended 60 cm over the external walls. While the survey included three categories for the size of the roof overhang – 30 cm, 31 cm to 60 cm, or more than 60 cm - too few dwellings had overhangs of more than 60 cm to be included as a separate category, resulting in the inclusion of just two: 30 cm or less and 31 cm or more. This made direct comparison with practice guidelines difficult. Numbers were again a concern with respect to walling; too few households had either unplastered (6%) or vibracrete (9%) walls to support stand-alone categories. Instead, these households were included as ‘unplastered’ in a two-point indicator on plastering.

As noted in Chapter 4, more detailed data on guttering and drainage infrastructure was also captured but was not included in the analysis as very few dwellings had either guttering or any kind of drainage infrastructure on the plot. Even when present, the qualitative research suggests that drainage infrastructure may have had a perverse impact on the findings. In Luyoloville, for instance, dwellings had gutters but these emptied onto a concrete apron surrounding the dwelling and not into a drain, suggesting that guttering is likely to increase rather than decrease the likelihood of problems.

Table 17: Summary of variables used in the statistical analysis

Variable	Answer categories/type
Type of dwelling	
	Contractor-built
	PHP
Main material used for the walls	
	Plastered blocks/bricks
	Unplastered blocks/bricks
	Vibracrete panels
Main material used for the floor	
	Cement with/without flooring
	Tiles
	Other
Height of floor relative to ground/street level	
	Same height
	Below

	Above
Main material used for the roof	
	Corrugated iron
	Tiles
	Asbestos
Type of roof	
	Flat
	Sloped
	A-shaped
By how much the roof overhangs the exterior walls	
	30 cm or less
	31cm or more
Space between house and neighbouring dwellings	
	50 cm or less
	51 – 100 cm
	101 cm or more
Proximity to a noticeable slope	
	Near a slope
	Not near a slope
Mitigation measures	
<i>Run-off</i>	
	Raised level of the floor
	Built a step around the house
	Dug channels to drain water away
	Raised level of the yard
<i>Seepage</i>	
	Laid a new floor slab/added concrete to the slab
	Put carpeting down to absorb water
<i>Structure-related</i>	
	Plastered or re-plastered walls
	Put in new roof or ceiling
	Covered roof with tar
	Painted walls with anti-fungal paint
Gender of the household head	
	Male
	Female
Elevation	
	As recorded by GPS
Average build-time	

	Average for settlement
Age of the household head	
	In years
Average monthly income per capita	
	Rand amounts

Given that some variables are more pertinent to particular problems than others, the analyses for run-off, seepage and structure-related problems were run separately, using only those characteristics relevant to each problem-type. Table 18 summarises the particular bundle of factors examined for each. All three analyses included variables on households' socio-economic characteristics, whether the settlement was contractor-built or developed under the PHP, and whether households had adopted measures to mitigate rain-related problems. The analysis for run-off included additional attributes on the spacing of dwellings and other characteristics that could make them prone to run-off, such as their proximity to slopes or the height of the floor relative to the surrounding ground. The models for seepage included indicators on the material used for the floor, and working on the assumption that houses built very rapidly are likely to be of a lower quality than those built more slowly, the average time taken to build the dwelling. The models for structure-related flooding contained the most numerous and detailed variables. These included the materials for the roof, floor and walls, roof features, the height of the floor, the spacing of dwellings and build-times.

As discussed in greater detail in Chapter 4, the modelling process starts with all the variables entered into the model. SPSS then uses statistical calculations to progressively remove those that do not influence the model's predictive capacity.³⁶ The variables that remain in the model once all the variables have been compared to

³⁶ Variables fall out of the model based on whether or not they are statistically significant. A statistically significant relationship denotes a relationship that is caused by something other than random chance. Statistical hypothesis testing is used to determine if a result is statistically significant or not. This provides a "p-value". In general, a p-value of 5% or less (p is less than 0.05) is considered to be statistically significant, meaning that there is a statistically measurable trend in the data; something is influencing the results in a non-random way. In the case of regression analysis, variables that are not statistically significant (have a p-value of more than 0.05) do not help to predict whether or not a household experiences rain-related problems and fall out of the model. The p-value appears in Sig. (p) column.

one another are those that best predict whether or not a household experiences problems.

Table 18: Summary of variables used in the regression analysis by problem-type

Variable type	Variable	Run-off	Seepage	Structural
Location	Elevation (height above sea level)	x	x	x
	Proximity to a noticeable slope	x	x	
Dwelling	Housing model	x	x	x
	Main material used for the walls			x
	Main material used for the floor		x	x
	Height of floor relative to ground/street level	x		x
	Main material used for the roof			x
	Type of roof			x
	By how much the roof overhangs the exterior walls			x
	Space between house and neighbouring dwellings	x		
Socio-economic	Gender of the household head	x	x	x
	Age of the household head	x	x	x
	Average monthly income per capita	x	x	x
Other	Average build-time		x	x
	Involvement in shaping and monitoring construction			x
	Mitigation measures	x	x	x

The spatial analysis explores the influence of topographical features. These include households' elevation and proximity to slopes, waterbodies and drainage features in driving rain-related problems, particularly with respect to run-off and seepage. It compares the data on households' experience of flooding with the topographical features of each site. The spatial analysis focuses exclusively on run-off and seepage, as these problems are the most likely to be influenced by geography, with topography unlikely to influence the experience of structure-related flooding.

The next section begins to test the hypothesis developed in Chapter 6 that poorly designed settlements and badly constructed buildings serve to perpetuate risk in subsidised housing areas. It examines the factors influencing the experience of run-off and seepage. The section explores particularly the relative influence of topographical, settlement, dwelling and socio-economic characteristics.

Buildings versus geography: Examining the factors associated with run-off and seepage

This section begins by presenting the statistical analysis on the factors associated with run-off and seepage, followed by the spatial analysis. The former focuses primarily on the role of socio-economic and building-related attributes in explaining differences in realised risk, while the spatial component explores the influence of geographical characteristics. Building on the analysis in Chapter 6, the spatial analysis examines the factors influencing the differences between sites, and adds an additional layer to the overall analysis by also examining patterns within sites.

Buildings as sites of risk: Exploring the risk-factors for run-off and seepage

Table 19 (page 191) presents the modelling results for run-off and seepage. The results suggest that neither socio-economic factors nor geography play a significant role in determining whether households experience either run-off or seepage. Socio-economic variables such as the age and gender of the household head and income per capita did not feature at all in either of the final models. While it makes intuitive sense that dwellings in lower-lying parts of settlements or near to slopes should experience higher levels of run-off, and those in low-lying areas seepage, the analysis also fails to find a strong relationship between topography and the experience of problems. Proximity to a slope does not feature in the final model for run-off. Elevation appears in both models but is not a strong predictor. The likelihood of experiencing problems decreases as elevation rises, but the odds ratios ((Exp(B) value) in both cases is close to one, suggesting only a weak relationship (see Box 1).

Box 1: The odds ratio (Exp(B))

The odds ratio refers to the odds of an event occurring in one group to the odds of it occurring in another. In this analysis, the odds-ratio refers to the likelihood of a household experiencing a particular kind of flooding.

When calculating the odds-ratio, all variables are calculated in relation to a base category. If 'concrete floor' is used as a base category in exploring seepage, for example, the odds of dwellings with other types of floors experiencing seepage is calculated against those with concrete floors, to give a percentage of households more or less likely to experience seepage. The exception occurs where there is a numerical order to variables, such as in the case of age or elevation. In these instances only one value is calculated, with the results showing the changing odds of experiencing a particular type of flooding given a one-point increase in the variable concerned.

The closer the odds are to one, the weaker the effect of a particular factor on flooding and vice versa. If the odds are one, the dwelling in question is as likely as those in the base category to experience problems. Odds ratios greater than one show that they are more likely to experience problems, while values less than one indicate that they are less likely.

The confidence interval (CI) for Exp(B) provides an indication of the range within the value of the Exp(B) falls. In this case, if we ran 100 experiments and calculated the Exp(B) for each, the value of Exp(B) in the population would fall within the upper and lower parameters at least 95% of the time. The smaller the range between the upper and lower values the better.

Features of the built environment have a greater impact. Housing type is influential in both cases, with households living in contractor-built dwellings substantially more likely to experience run-off than those in PHP housing. Households in contractor-built settlements were more than four times as likely as those in PHP housing to experience run-off, and were more than twice as likely to experience seepage. As discussed in Chapters 3 and 5, this may reflect design issues. It is plausible that homeowners in PHP settlements have greater input into how their dwelling is designed and built, while the individualised approach may allow for more responsive designs that are better tailored to the prevailing conditions, both of which could help to reduce the experience of problems. Build-time does not feature in the model for run-off, but does

appear in the one for seepage, with the likelihood of experiencing problems decreasing as build-time increases. While only a proxy measure for the quality of construction, longer build-times plausibly indicate more care in construction and greater time for concrete and other materials to cure and settle. Further analysis of the data shows that build-times were generally longer for dwellings built under the PHP programme, with construction taking an average of 21 days compared to 13 days for contractor-built dwellings.

Turning to problem-specific factors, the model for run-off suggests that the distance between dwellings plays an important role in determining whether households experience problems. Run-off was substantially more likely where houses were built close together. Dwellings built 50 cm or less from neighbouring dwellings - well below the minimum 60 cm stipulated in official guidelines - were almost four times more likely to experience run-off than those spaced further apart. The height of the floor relative to the surrounding ground was significant in early iterations of the model, but this factor was eliminated statistically in the final model. One might expect the type of floor to influence the likelihood of experiencing seepage, but floor-type is not a predictor, probably because most formal housing has concrete or tiled floors.

Table 19 suggests an ostensibly counter-intuitive relationship between the adoption of mitigation measures and the experience of flooding. The adoption of mitigation measures does not feature in the model for seepage. However, the results show that households adopting measures to address run-off were more rather than less likely to experience problems. Unfortunately, it is difficult to determine whether this is due to the efficacy of different strategies. Although this was the initial objective of the question, the questionnaire did not ascertain when measures were implemented, making it impossible to determine whether households adopted measures before or after the latest and/or most serious case of run-off. This makes it difficult to establish a firm connection between mitigation and risk. It is likely that instead of indicating the effectiveness of measures, the finding reflects the fact that people who experience problems are more likely to take steps to address them. Removing mitigation measures from the model has little effect on the other variables, with housing type, elevation and distance between dwellings remaining the most influential factors.

Table 19: Factors affecting the likelihood of dwellings experiencing run-off and seepage

Variable	SE(B)	Sig. (p)	Exp(B)	95% CI for Exp(B)	
				Lower	Upper
Run-off* (n=246)					
Housing type					
Contractor-built	0.425	.000	4.791	2.081	11.031
Elevation	0.025	.003	0.927	0.882	0.974
Distance between houses					
50 cm or less	0.360	.000	3.899	1.925	7.895
Adopted mitigation measures					
Adopted measures	0.476	.030	2.806	1.104	7.136
Constant	0.700	.303	0.487		
Seepage** (n=245)					
Housing type					
Contractor built	0.399	.030	2.374	1.087	5.185
Elevation	0.026	.000	0.893	0.849	0.939
Average build-time in settlement	0.018	.000	0.936	0.904	0.969
Constant	0.670	.001	8.802		

*Hosmer & Lemeshow .732, Cox & Snell .170, Nagelkerke .249³⁷

**Hosmer & Lemeshow .108, Cox & Snell .180, Nagelkerke .263

In summary, the findings of the statistical analysis support the case for buildings as sources of vulnerability identified in the previous chapter. They suggest that settlement planning and the quality of buildings do play a crucial role in determining whether households experience problems. Socio-economic factors do not feature as sources of risk. One might expect topography to play a role, but the findings suggest that geography has very little influence. Elevation has a weak influence on outcomes, but it is less important than dwelling and settlement characteristics. In keeping with the qualitative research, the results show that features of design and the quality of construction best predict whether households experience run-off or seepage. In the

³⁷ These tests show the strength of the model. The Hosmer and Lemeshow Test show how well the model fits the data. The result should not be significant (less than 0.05). The Cox and Snell and Nagelkerke statistics approximate the R-squared values obtained in linear regression. They indicate the improvement brought about by adding the variables in question to a null model. The closer the value to 1, the greater the improvement achieved by adding the variables.

case of run-off, the spacing of dwellings, and possibly, levels of innovation and the care with which houses are built influence the likelihood of experiencing problems. The findings for seepage also point to quality issues, with average build-times linked to varying levels of realised risk.

The next section extends the analysis of the role of geographical factors in driving risk. Drawing on both the data collected in the survey and the spatial data collected for each site, the analysis compares households' experience of run-off and seepage with their proximity to water bodies and drainage features. Given the difficulties of accurately capturing households' position relative to high and low areas in a survey, the analysis also revisits the relationship between rain-related problems and households' proximity to slopes, as well as other differences in elevation.

It engages not only the relative influence of geography compared to features of settlements and dwellings, but also issues of scale. As explored in Chapter 2, flooding is often conceptualised at a collective or covariate level. Many discussions acknowledge that levels of vulnerability vary between individuals and households, but the emphasis is often on at-risk groups of various sizes and kinds. This is particularly so with the literature on flooding, where the emphasis has historically been on large-scale, intensive events such as overflowing rivers, storm surges and tsunamis. This section examines how appropriate this approach is in the context of subsidised housing, where 'flooding' appears of a more idiosyncratic nature.

Buildings versus topography: Examining geography and risk

This section presents the findings of the spatial analysis of the relationship between topography and run-off and seepage. The section begins by examining the elevation data for the study areas as a whole, before examining the relationship between elevation and problems within each site. It then explores whether there is a relationship between flooding and dwellings' proximity to permanent and seasonal waterbodies, such as streams, wetlands and detention ponds. Although not water bodies in the conventional sense, this analysis includes surface drainage features such

as major ditches and canals since, as discussed in Chapter 6, these are known to overflow during the wet season, with the same effect as a stream or other water feature.

Figure 34 shows the elevation of the research areas. The pink, purple, and light blue shading shows lower-lying areas and red, orange and yellow shading indicates higher-lying areas. The map shows that although Philippi and Guglethu are relatively low-lying overall, there is variation between sites. Better Life is the highest above sea level, with an elevation of between 37 m – 40 m above sea level. Samora Machel shares a similar profile to Better Life, but parts are lower lying, with an average elevation of roughly 30 m above sea level. New Rest, Luyoloville and Vukuzenzele have the lowest elevations, with an average height of between 20 m and 25 m above sea level. Within site variation was greatest in Samora Machel, where the highest and lowest points in the settlement showed a difference of more than 20 metres.

These differences do not, however, correlate with the experience of run-off and seepage. Recapping the findings discussed in the previous chapter, Figure 35 shows the proportion of respondents in each research site that reported having experienced run-off or seepage. The blue bars show the proportion that experienced run-off and the red bars those that reported seepage. The graph shows that, while some higher-lying areas show fewer problems and vice versa, this is not the pattern in all the sites, suggesting a weak relationship between elevation and the experience of problems. Higher-lying Better Life shows relatively low levels of run-off and seepage and low-lying Luyoloville the highest, but comparing Figure 34 and 35 shows that low-lying New Rest also experiences the lowest levels of both run-off and seepage. Similarly, although it lies at much the same elevation as the settlements in the Gugulethu cluster, Vukunzenzele also experiences fewer problems than Samora Machel, which lies at a higher elevation.

Figure 34: Elevation levels in the five informal sites

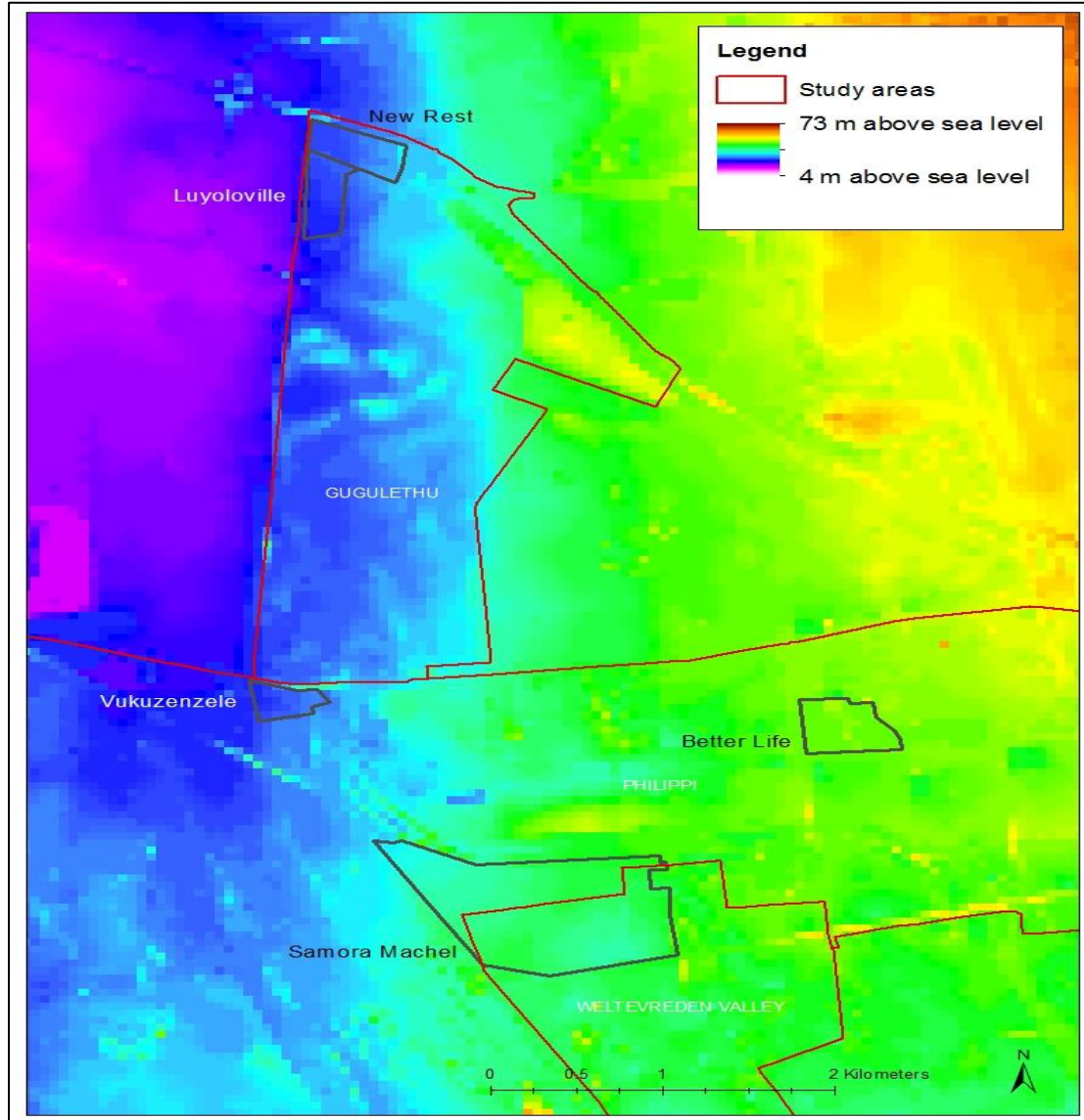
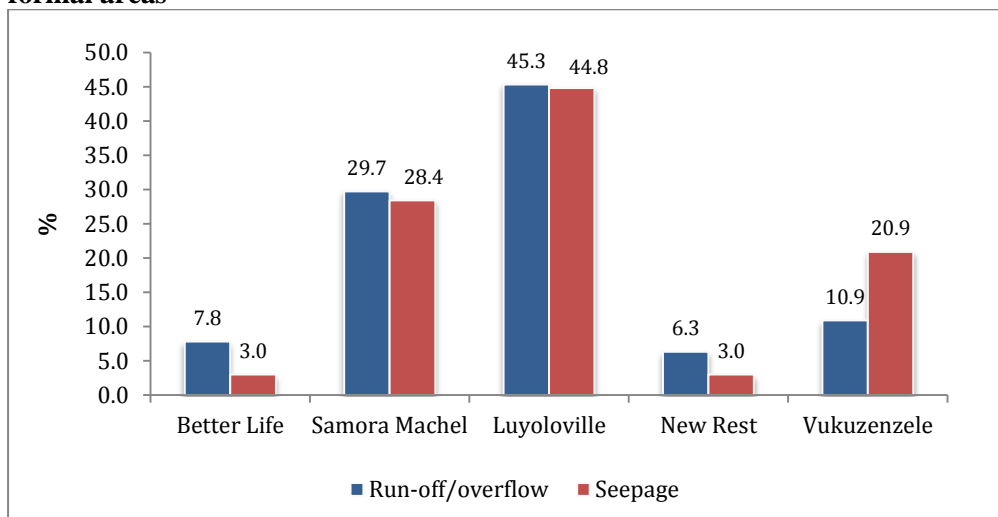


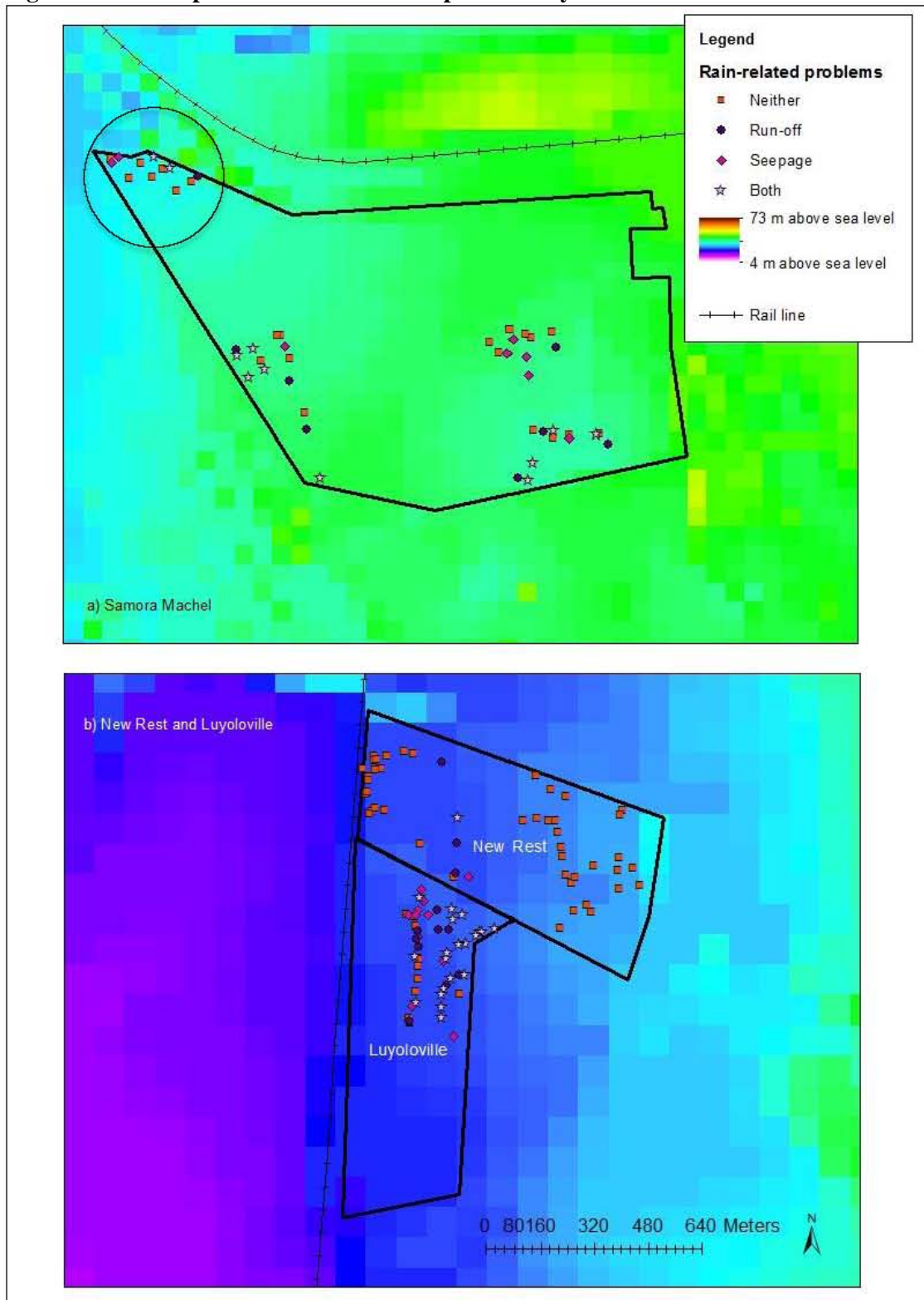
Figure 35: The proportion of households experiencing run-off and seepage in formal areas

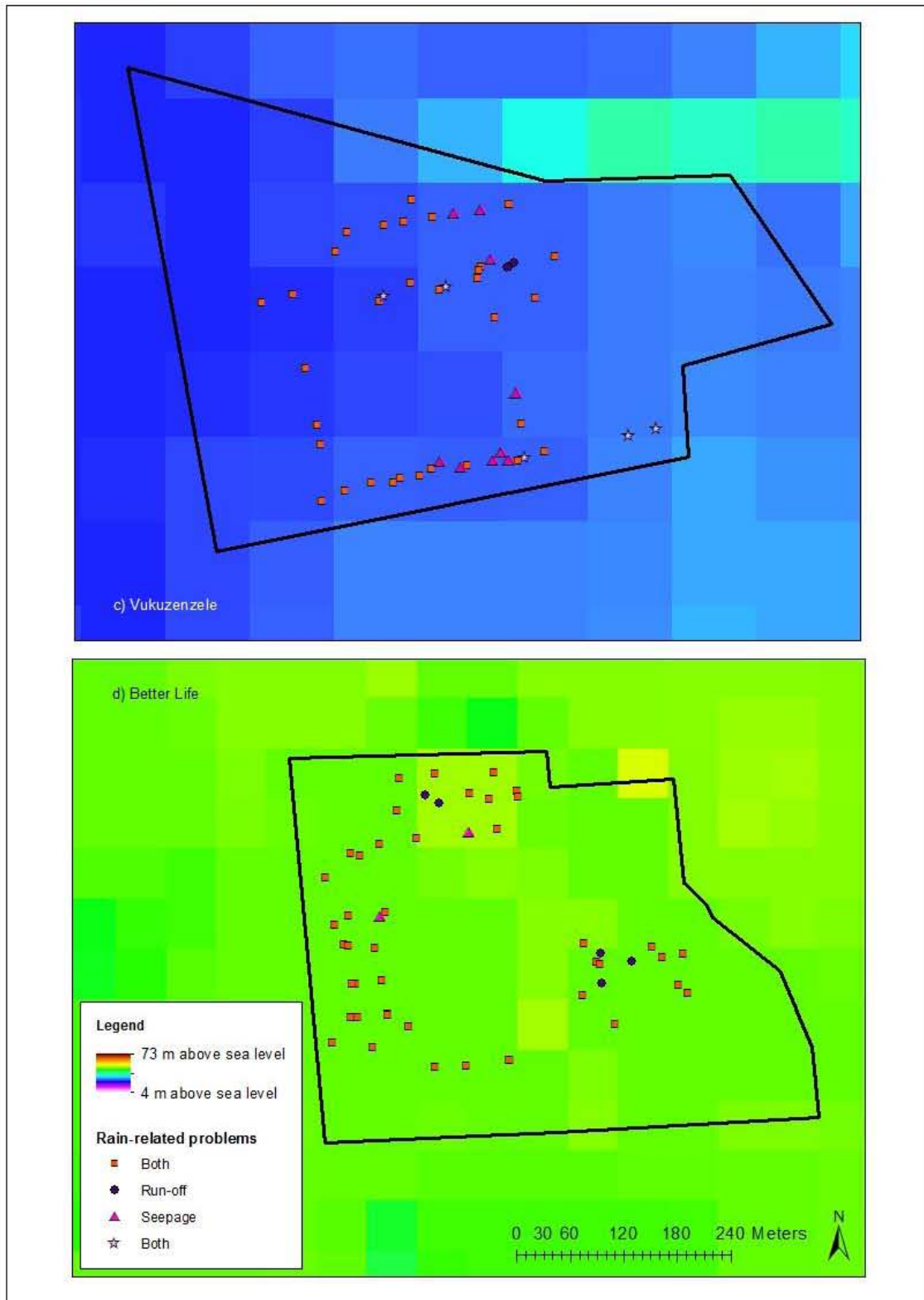


The qualitative research suggests a relationship between topography and the experience of rain-related problems within settlements. Focus group participants in Samora Machel argued that run-off, in particular, was a problem in the northwestern corner of the settlement, where households were located close to a wetland, and along a railway track on the northern border of the settlement, where dwellings backed onto a steep embankment. Respondents also reported that a detention pond in the south of the settlement sometimes overflows, with water not only entering houses, but also reportedly causing problems for motor vehicle and pedestrian traffic. Focus group participants in Luyoloville also identified problem areas, particularly along the settlement's eastern edge, where there was a large, concrete surface-level drain that was reportedly prone to overflowing. Participants in Vukuzenzele noted that seepage was a particular problem along the settlement's southern border with Sweet Home, where surface run-off tended to accumulate.

However, the spatial analysis fails to find a robust relationship between landscape and flooding, although topographical features cannot be completely discounted. The strongest evidence for a link between elevation and flooding comes from Samora Machel, where within-site variation was most pronounced. Figure 36a plots the households experiencing run-off or seepage against the elevation data. The dark purple dots mark households experiencing run-off, the medium purple dots those experiencing seepage, and the light purple dots dwellings experiencing both run-off and seepage. The orange squares show households reporting neither problem. Allowing for a degree of imprecision in the placement of the data points, the map suggests that households living at the bottom of a slope in the north western corner of the settlement – marked by the circle - are slightly more likely to experience run-off and seepage. However, as Figures 36b-d show, analysis of the other sites provides little evidence of a relationship between geography and the experience of problems.

Figure 36: Experience of rain-related problems by elevation



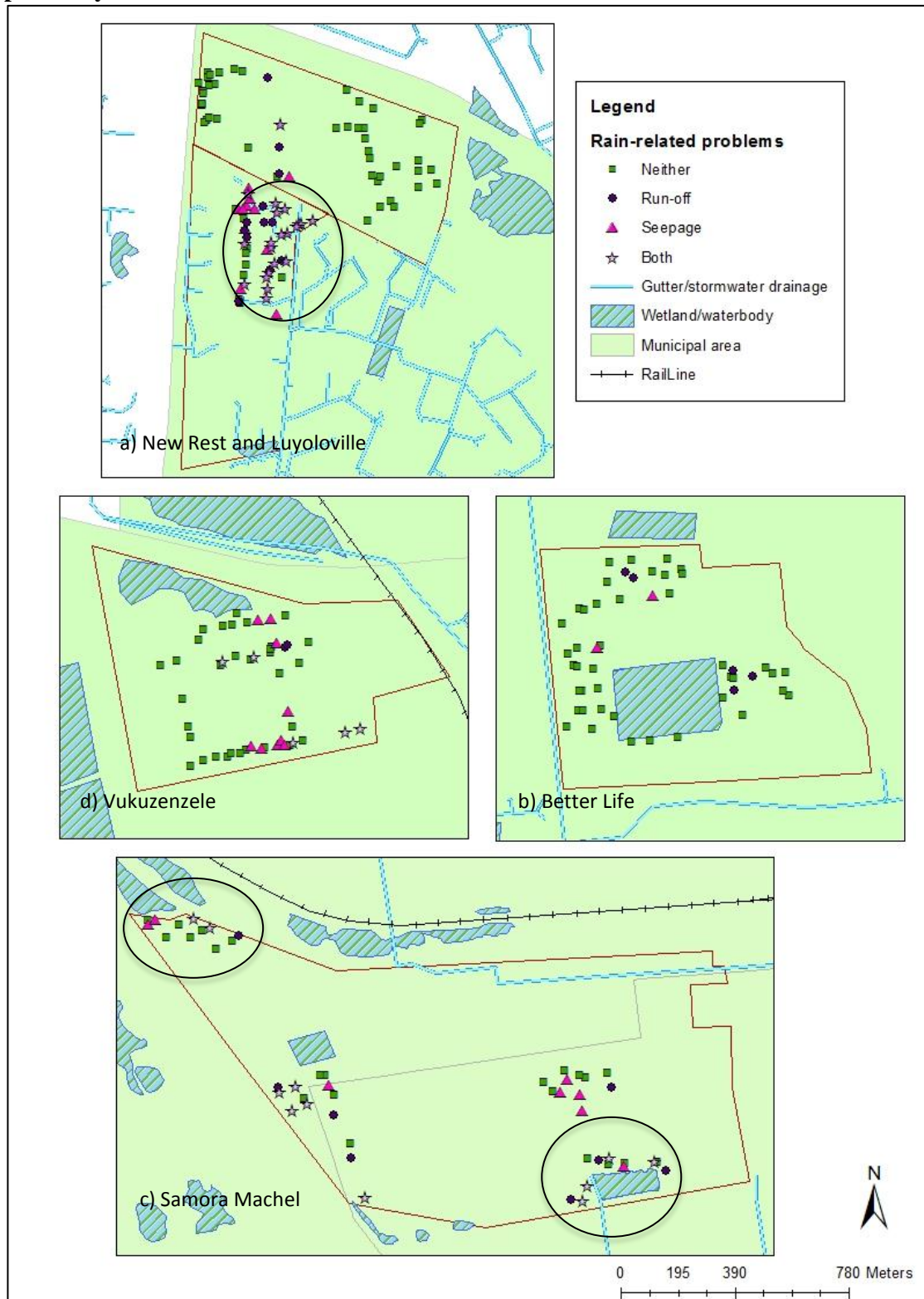


The spatial analysis also fails to find a strong correlation between flooding and dwellings' proximity to wetlands and other waterbodies. While the analysis found a weak correlation between flooding and proximity to wetlands and drainage

infrastructure in informal settlement areas (see Appendix 5), there is no obvious relationship in the formal settlements. Figures 37a-d plot the households experiencing run-off and seepage in relation to water bodies in and around settlements, including permanent and seasonal wetlands, watercourses and detention ponds, surface gutters or other drainage infrastructure. The dark purple dots mark households experiencing run-off, the medium-purple dots seepage and the light purple dots households experiencing both. The green squares indicate households that did not report any run-off or seepage. As the figures show, there was no obvious link between dwellings' position and their experience of rain-related problems in three of the five settlements, although there is some evidence of an association in Samora Machel and Luyoloville. In line with the qualitative data, there was some clustering of run-off and seepage around the wetland and detention pond in Samora Machel (Figure 37c), as well as around drainage infrastructure in Luyoloville (Figure 37a). For the most part, however, the rain-related problems were not obviously associated with topographical features.

Both these threads of analysis highlight, however, the diversity of experience that exists within sites. Plotting the experience of problems against elevation and proximity to water bodies and drainage features shows that households adjacent to one another often have quite different experiences, even in highly standardised settlements like Better Life and New Rest. While one household may experience run-off or seepage, a neighbouring dwelling may experience only one of these, and others no problems at all. This could partly reflect inaccuracies in the reporting of problems. However, this diversity persists across all of the five sites suggesting that, even if some respondents did under- or over-report problems, this is a trend. These idiosyncrasies suggest that risk accumulates and manifests in very individualised ways in subsidised housing settlements; while the levels and types of flooding differ between settlements, households' experiences also vary within settlements. This suggests that the likelihood of experiencing problems drills down to the skill and attention paid by individual workmen or teams. Vulnerability in this instance is rooted in individual dwellings; it is not the immediate characteristic of certain people or groups that make them vulnerable, but living in a particular building. It also suggests vulnerability may be transitory; as people move in and out of dwellings, the likelihood of experiencing run-off or seepage changes.

Figure 37: Experience of run-off and seepage in subsidised housing settlements by proximity to water bodies



This variation speaks to the problem of applying the concepts of risk and vulnerability too coarsely. As with the differences between sites, the findings highlight the pitfalls of oversimplifying the conceptualisation of how risk accumulates, even at a neighbourhood scale. The differences between households also challenge the prevailing tendency to conceptualise risk in covariate terms. As discussed in Chapter 2, most discussions recognise that risk and vulnerability accumulate at the individual and household level, but research and practice on flooding, in particular, often conceptualise and apply these concepts at the level of communities, geographical or administrative areas, and sometimes nations. Instead of focusing on what makes particular people or households vulnerable, the emphasis is often on ‘at-risk’ populations. The findings suggest that there is a need for a more nuanced, process-focused approach. As in Chapter 6, they also indicate that making blanket assumptions about who is vulnerable and to what they are vulnerable obscures the complex dynamics driving flood-risk.

In summary, the spatial analysis supports the findings for both run-off and seepage. While the five formal sites show highly variable problem profiles, these differences do not appear obviously linked to topography. Although the GIS analysis finds a weak relationship between the experience of problems and the landscape in some sites, particularly in Samora Machel, other sites show no evidence at all, suggesting that neither elevation nor proximity to water bodies or drainage infrastructure plays a major role in determining whether households experience either run-off or seepage. In line with the findings of the statistical analysis, the spatial data suggests that geography cannot be discounted completely, but that features of the built environment drive risk in subsidised housing areas.

The findings on the variable experiences of frequently nearby households also suggest that risk in subsidised housing areas accumulates and plays out in a highly individualised way. They suggest that it may be micro-level issues, particularly the quality of individual dwellings that often drive risk. This calls not only for greater care in how we understand risk in the local context, but also a less society-centric approach. Although the history and marginality of the Cape Flats undoubtedly influence risk, the findings suggest that the locus of vulnerability lies less in political ecology, and more in the individual characteristics of the physical, built environment.

The Cape Flats are prone to flooding, and its residents are impoverished and marginalised, but these issues are fairly distal; the nature of the built environment configures risk in an immediate and direct way. As discussed later, quality concerns are again influenced by larger political and socio-economic factors, but the findings continue to suggest that although macro-level factors are important, they play a less central role than envisaged in much of the prevailing literature.

The next section examines the factors influencing the likelihood of structure-related problems, including features of design and the building materials used. It begins by exploring the qualitative support for the hypothesis that buildings influence risk. It then presents the findings of the statistical analysis. This examines the role of materials, finishes and design issues, such the slope of the roof or the size of the roof overhang, in influencing households' experiences.

Design and quality: Examining the factors associated with structure-related problems

This section begins by examining the qualitative case for dwellings as sources of vulnerability. It explores the contrasting experiences of Kanana informal settlement, and the formal settlements of Luyoloville and New Rest, which despite being close to one another show very different levels and types of concerns. Drawing on the qualitative research, the section explores possible reasons for these differences. It then presents the statistical analysis, which explores quantitatively the factors influencing structure-related flooding.

Same environment, different problems: The qualitative case for buildings as sources of vulnerability

Figure 38 shows, the location of the three sites. Luyoloville (outlined in blue) and New Rest (in purple) lie adjacent to each other, while Kanana (in green) lies opposite New Rest on the other side of the NY1/Steve Biko Drive. As discussed in Chapter 5,

all three settlements lie on old landfill sites, close to wetlands that are prone to flooding. New Rest was formerly an informal settlement and was upgraded under the UISP, with the formal development located on the original land. It comprises primarily contractor-built dwellings. Luyoloville comprises a greenfield gap-housing project developed by the CTCHC in 2000, along with seven other sites in Gugulethu and Philippi.

Despite their proximity, the three settlements show very different risk profiles. As discussed in Chapter 5, the DRMC identifies Kanana as amongst the most flood-prone informal settlements on the Cape Flats. Households in Kanana experience seepage, leaks when rain is accompanied by high winds and some run-off. However, adjacent New Rest experiences few problems, despite sharing the same geographical conditions. Prior to its upgrading under the UISP, New Rest informal settlement was in fact included in the DRMC's list of high-risk settlements – appearing in the City of Cape Town's winter preparedness strategy as recently as 2009 (as reported in Ziervogel and Smit, 2009). Luyoloville, by comparison, experiences high levels of seepage, run-off and leaks, with the latter linked to the construction and finishing of dwellings as opposed to wind.

The most obvious explanation for these differences between the sites is the quality of dwellings. New Rest's transition from a high-risk informal settlement to a low-risk formal one suggests a well-built development, designed and engineered in a manner appropriate to its location. It indicates that subsidised housing can overcome spatial and geographical disadvantages when built to a high standard - although even New Rest experiences some problems, implying that weaknesses in processes and/or implementation remain even in 'successful' developments. The persistent problems in Luyoloville, on the other hand, suggest a poorly prepared site and poor build-quality, especially given its status as a supposedly superior gap-market development.

The qualitative research suggests that quality is important in explaining the different outcomes in the three settlements. It shows that some of the run-off experienced in Luyoloville is linked to a drainage canal running down the settlement's eastern border, which overflows, but it also highlights poor design and construction. As Figure 39a shows, houses in Luyoloville all had gutters, but these emptied onto a concrete apron

surrounding the dwelling and not into a drain, resulting in pooling around the dwelling. This problem was worsened in some properties by poorly laid aprons, which sloped slightly towards the dwelling and/or were positioned below the surrounding ground, drawing water towards the dwelling (Figure 39b). The qualitative findings also suggest that the seepage experienced in Luyoloville is in large part due to poor building practices. Focus group participants linked the high levels of seepage in the settlement to poorly laid floor slabs, slabs that were too thin, and problems with the cement-mix. They reported at least one instance in which a concrete floor slab was never laid.

Figure 38: The location of Kanana, Luyoloville and New Rest



These findings find support in other research. In her study on the CTCHC, Trish Zweig (2006) identifies tenure, procedural and quality issues in Luyoloville and several other settlements. As discussed in Chapter 5, her research found that the company failed to adhere to national building procedures and standards. It found that

eight settlements, including Luyoloville, were not built according to the terms of National Housing Code, and were never inspected by the authorities, allowing for the use of poor-quality materials and substandard building practices. The research also found evidence of inadequate supervision by the company and rushed work, both of which permitted poor building practices, including hastily thrown flood slabs (Zweig, 2006).

Figure 39: Examples of poor design in Luyoloville (November, 2010)



Figure 39a: Guttering without drains



Figure 39b: Concrete aprons sloping towards dwelling; below ground level

In line with the findings presented in the previous chapter, this case study suggests that quality concerns are important in understanding risk. The fact that communities so close to one another show such diverse experiences suggests that the quality of design and construction play a key role in determining whether dwellings experience leaks, seepage or run-off. New Rest's transition from a high-risk informal settlement to a much less flood-prone formal development provides particularly strong support for the argument that design and quality influence levels of realised risk. The next section explores these arguments statistically.

A more nuanced picture of risk: Examining the sources of structure-related problems

Table 20 presents the model results for structure-related problems. This model was the only one of the three to include socio-economic variables. The table shows that the likelihood of experiencing structure-related problems increased with the age of the household head, but the odds ratio is very close to one, indicating a weak relationship.

This suggests that age is not particularly important in understanding risk. That age appears in the final model at all may reflect different levels of capacity with respect to building or repairing dwellings.

In line with the preceding results, the findings suggest that building characteristics and quality issues are important in determining risk. The results create a more nuanced picture of influences than with the other problem-types. While housing type was significant in early iterations of the model, it fell out of the statistical analysis relatively early on, suggesting that it is specificities of design and quality that drive structure-related problems in both PHP and contractor-built dwellings. There are two possible explanations for this. These subtleties may simply be more visible in the case of leaks, as more detailed questions help to unpack the nature of risk more effectively. The findings could also reflect the greater complexity of building top-structures compared to floors, and problematic building practices in both housing types, particularly given beneficiaries' limited knowledge of construction (see Chapter 6).

The findings reinforce the role of dwelling characteristics and build-quality in driving realised risk. As with the other problem-types, the likelihood of experiencing flooding decreases as build-time increases. In keeping with the qualitative research, the findings also show that dwellings with unplastered walls, including those built with vibracrete, were more than five times as likely as plastered houses to experience leaks. The pitch of the roof does not feature in the final model, but the main type of material used does. Of the three types of roofing material examined, only corrugated iron and tiles had a statistically significant impact on the likelihood of experiencing problems. Dwellings with tiled roofs were more likely than those with corrugated iron roofs to experience problems. In line with the qualitative data, dwellings with small overhangs were also more likely to experience leaks.

The findings on the roof materials could be due to differences in the design of contractor-built and PHP settlements, rather than the performance of the materials. Specifically, the findings could reflect the generally higher level of problems experienced in standardised RDP-type settlements, which tend to have tiled roofs. In order to test this hypothesis, the model was re-run using only PHP dwellings, which are likely to use a wider range of materials. These results echoed the previous findings,

with dwellings with corrugated iron roofs less likely to experience problems than those with tiled roofs. These findings are likely to reflect again the quality of workmanship. According to an architect involved in the PHP, tiled roofs often perform better than corrugated iron roofs, which are prone to leaks if joins are not sealed properly - but only if they are laid correctly. Poorly laid tiles, or a failure to seal the joins properly where the roof and walls meet, are likely to result in leaks (Cuff, personal communication, November, 2010). In this context, the findings suggest that it is not the material used that influences the experience of problems, but how well roofs are constructed.

Table 20: Factors increasing the likelihood of subsidised dwellings experiencing structural problems (n=246)

Variable	SE(B)	Sig. (p)	Exp(B)	95% CI for Exp(B)	
				Lower	Upper
Walls plastered or unplastered					
Unplastered	0.615	.005	5.734	1.718	19.136
Main roof material					
Tiles	0.415	.032	2.430	1.077	5.484
Asbestos	0.545	.121	2.327	0.800	6.768
Roof overhangs external walls					
Roof overhangs by less than 30 cm	0.342	.020	2.216	1.132	4.335
Average build-time in settlement	0.014	.000	0.092	0.904	0.954
Age of the household head	0.014	.026	1.031	1.004	1.059
Constant	0.784	.880	0.888		

Note: Hosmer & Lemeshow .915, Cox & Snell .244, Nagelkerke .328

As in the case of run-off, the findings suggest a counter-intuitive relationship between the adoption of mitigation measures and the experience of run-off. The results show that households adopting measures to address run-off were more rather than less likely to experience problems. As discussed earlier, it is impossible to determine whether households adopted measures before or after the latest and/or most serious case of run-off, making it difficult to establish a firm connection between mitigation and risk. It is likely that instead of showing the efficacy of measures, this finding again reflects the fact that people who experience problems are more likely to take

steps to address them. As with run-off, removing mitigation measures from the model has little effect on the other variables, with housing type, elevation and distance between dwellings remaining the most influential factors.

In summary, the findings show that, as with run-off and seepage, the design and quality of dwellings plays a key role in determining whether dwellings show serious leaks. In keeping with the qualitative data, the statistical analysis shows that buildings are central in understanding flood-risk in Cape Town. Socio-economic factors, in this case the age of the household head, exert some influence, but the model suggests that it is features of design and the quality of construction that have the greatest bearing on why some households experience structure-related problems and others do not.

Overall, the statistical and spatial analyses confirm the importance of buildings in driving rain-related problems. The findings suggest a weak correlation between topography and run-off and seepage. They also show a relationship between and socio-economic factors and structure-related problems. However, the results indicate that neither geography nor socio-economic attributes predict well the likelihood of households experiencing run-off, seepage or leaks. The triangulation of the qualitative, quantitative and spatial data shows that it is the layout of settlements, dwelling characteristics and the quality of construction that have the greatest bearing on levels of realised risk. These findings challenge prevailing assumptions about the sources of flood-risk, and risk more broadly. They show that flooding in subsidised housing areas in Cape Town is neither rooted primarily in geophysical factors, nor socio-economic issues. Moreover, while the literature often focuses on the social dimensions of risk, the findings suggest that understanding flooding in subsidised housing areas also requires a much sharper focus on the built environment.

This does not, however, mean that risk is not influenced by broader macro-economic and political issues. In addition to historical patterns of social exclusion on the Cape Flats, housing concerns are rooted in a range of macro-political and economic dynamics. As discussed in Chapter 3, South Africa's subsidised housing programme has experienced a range of challenges. These include the continued peripheralisation of subsidised housing developments, the political pressure to deliver housing as rapidly as possible, and ongoing resource and capacity constraints that compromise

local governments' ability to deliver sufficient, high-quality housing. Drawing primarily on the qualitative research, the next section explores some of these issues with respect to housing delivery in Cape Town.

Standards, capacity and accountability: Exploring the social production of risk

The qualitative research highlights several broad dynamics influencing risk in subsidised housing settlements. As discussed in Chapter 3, government is under enormous political pressure to deliver housing and get as much house as possible for the available subsidy. Contractors are, in turn, under pressure to deliver quickly, and face limited profit margins, which encourages developers to cut corners. It is widely recognised that local government is also under-resourced, a situation exacerbated in Cape Town by efforts to streamline and rationalise local government in the city. Against this backdrop, this section examines three issues: the standards applied to subsidised housing, levels of monitoring and oversight in the subsidised housing sector and the frequently limited levels of accountability in the sector.

The qualitative research suggests that there is sometimes a trade-off between costs and standards. This is shown most clearly in the case of cavity walling. As discussed in Chapter 5, Cape Town falls within the SCCPA. Houses in this zone are required by the National Building Regulations to have ceilings with insulation (Human Settlements Department, 2009), while good practice encourages the inclusion of cavity walls, waterproof plaster and paint, and windows with a water-resistant finish (Cuff, personal communication, November, 2010). Cavity walls – double walls separated by a gap designed to drain away any moisture that penetrates the external wall before it reaches the internal wall – are a particularly powerful intervention. However, while higher-cost formal dwellings in Cape Town's wealthier suburbs usually have cavity walls as standard, the majority of subsidised dwellings have only single-skin walls. This is primarily due to the added expense and time required to build cavity walls (Cuff, personal communication, November, 2010; Wust personal communication, November, 2010), with most double-walling confined to PHP settlements. As noted by the architect involved in the PHP programme, the housing

subsidy is simply too small to cover anything that is not essential; cavity walls, and even items like gutters are too costly and time-consuming to include (Cuff, personal communication, November, 2010).

The quantitative research also suggests a more general failure to meet either national or good practice guidelines. As discussed in Chapter 5, the data on dwelling features shows that subsidised dwellings often fail to meet either South Africa's National Building Code or unofficial standards - guidelines that, if met, would greatly reduce the likelihood of rain-related problems. The extent to which the roof overhangs a dwelling's external walls plays a key role in preventing water from driving rain reaching walls, but most extended less than the recommended 60 cm over dwellings' external walls. This was particularly so in the large standardised developments such as Better Life and New Rest. The majority had floors below street level, and many did not have insulated ceilings, particularly in Samora Machel and Vukuzenzele. In Better Life, there were often no panels or trap doors covering access points. These findings find support in other research. As noted earlier, Zweig's (2006) research into the CTCHC also identified several procedural problems, including a failure to adhere to national building procedures and standards.

The qualitative research suggests that this may be due to low levels of monitoring, oversight and quality control. This was not a focus in this study, but research by others suggests that the often poor standard of subsidised housing is frequently due to insufficient levels of supervision by over-burdened building inspectors and, in the case of self-build developments, inadequate training of beneficiaries, either in building or supervision skills (see for instance, Mkuzo, 2011; Wenzel, 2010; Ntema, no date). The qualitative research found some evidence of similar problems in Cape Town. While it is impossible to verify the accuracy of the reports, focus group participants in Better Life stated that their dwellings had never been inspected. As noted previously, Zweig's (2006) research found that the authorities failed to inspect several of the settlements built by the CTCHC, including Luyoloville. It suggested that the company too failed to adequately supervise its projects, which contributed to poor building practices. As discussed in the previous chapter, respondents in Vukuzenzele also attributed some quality issues to their limited expertise in building,

with many having turned to cheap, inexperienced contractors rather than building houses themselves.

These findings point to a third issue: limited accountability. The research suggests that beneficiaries have limited power to hold contractors accountable for poor work. Again, this was not explored extensively in this study, but the data from the focus group discussions suggest that homeowners' attempts to get their homes repaired met with varying degrees of success. In Better Life, for instance, beneficiaries reported that they had repeatedly approached the contractor – who was still onsite and building dwellings in the newest phase of development at the time of the research – to fix problems, such as incomplete roofs and cracked walls. However, while some had been helped, many had yet to have their concerns addressed.

Other communities had had more success, but progress was often uneven. In Luyoloville, for example, beneficiaries had achieved some, but not full accountability. In 2007, under pressure from local communities and political parties, the CTCHC was ordered to undertake repairs in several of its developments, including Luyoloville. However, these repairs were often of a poor standard and, at the time of the research, many problems had yet to be fixed. Community leaders reported repeatedly approaching their local councillors for assistance, but to limited effect. By 2010, focus group participants reported that residents were boycotting the payment of their bonds with the company. Although they were receiving help from the Western Cape Anti-Eviction Campaign to publicise their case, many faced eviction for non-payment.

These accountability issues appear influenced by both beneficiaries' perceptions of what is due to them, and perhaps even what outsiders consider necessary. The focus group discussions suggested a pervasive sense that beneficiaries must be grateful for receiving a house, no matter how flawed. As noted by an elderly focus group participant in Luyoloville: “you can't refuse to take a house; you get tired to stay 30 years in a shack”. In as much as the larger political and social dynamics limits beneficiaries' power to hold role-players accountable for a poor product, many did not feel that they had the right or power to demand better housing. The lack of response by contractors and local councillors may also reflect beneficiaries' limited political power, and a sense that some trade-off in standards is acceptable.

Buildings as sites of risk: Conceptualising the drivers of rain-related problems in subsidised settlements

These macro-level issues help to create an environment conducive to corner-cutting and poor quality, but the primary drivers of risk lie in the built environment. In line with the findings in Chapter 6, the results suggest that it is primarily poorly designed and constructed buildings that leave households in subsidised housing vulnerable to run-off, seepage and leaks. While the literature on risk and risk reduction tends to privilege the societal issues driving risk and vulnerability, the statistical and spatial analyses suggest that features of the built environment play a pivotal role in increasing flood-risk in poor formal settlements in Cape Town.

This does not discount the role of macro-level factors. Instead, it suggests the need for a broader, but more precise perspective. Rather than focusing only on the socio-political and economic processes that result in substandard dwellings, the analysis suggests that buildings need to be factored into the conceptualisation of risk. As with the literature on seismic risk, poor design and construction are central to the construction of risk. As explored in Chapter 2, discussions on earthquakes and earthquake protection recognise that features of the build environment are rooted in the socio-economic and political dynamics structuring society, but focus on the physical components of risk. They emphasise the role of factors such as siting, the shape, design, plan and age of structures, building materials, how well buildings are maintained and their linkages to other structures in mediating risk (Davis, personal communication, December 2012; Arammbebola, 2007; Hosseini, 2007; Anbarci et al, 2005; Alexander, 2000). I argue that just as this literature highlights earthquake resistant design and construction methods, and the establishment and enforcement of appropriate building codes, discussions on flooding need to include a physical, built environment component. The findings also suggest the need for greater precision in how we discuss risk. Instead of making broad generalisations about vulnerable housing types, such as 'slums' or informal housing, or even subsidised housing, it is necessary to examine the particular characteristics that increase vulnerability, including building features.

The findings on the variable experiences of neighbouring households also suggest a need to revisit the scale at which risk is understood. In line with the findings on different settlements' experience of problems discussed in the previous chapter, this variation highlights the dangers of oversimplifying how risk accumulates and manifests. It points to the need for a more nuanced approach that focuses on the processes that make certain households more vulnerable than others. The findings also suggest that, while it may make sense to conceptualise conventional flood-risk in covariate terms, 'flooding' and its derivatives in contemporary urban environments such as Cape Town is better conceptualised in a more idiosyncratic manner. As in the food security literature, where assessments of food insecurity take a micro-level perspective, the results suggest that the emphasis must be on micro-level dynamics. To paraphrase Burg (2008), I argue that discussions need to focus on how best to determine which people are more vulnerable, and why.

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CHAPTER 8

A More Nuanced Concept of Risk: The Implications for Theory and Practice

Introduction

This thesis tested prevailing assumptions about risk generally, and flood-risk in particular. It took as a case study urban flooding in subsidised housing in Cape Town. Drawing on the theoretical discussions explored in Chapters 2 and 3, Chapters 6 and 7 it examined how well the local experience of flooding fits prevailing assumptions about what constitutes ‘flooding’, the drivers of risk and the consequences for affected households. Referring to the schematic diagramme on the construction of flood-risk presented in Chapter 2, the research critiqued prevailing assumptions about the nature of flooding as a hazard, its triggers and impact. The research also tested assumptions about the sources of vulnerability, who is most vulnerable and the scale at which vulnerability and risk accumulate and manifest. The research interrogated four interrelated and overriding questions. When it comes to flooding:

- What is it that households in flood-prone areas are vulnerable to?
- Who is vulnerable to flooding?
- What factors drive vulnerability?
- At what scale does risk accumulate and how is it realised?

With reference to the local context specifically, I also tested empirically the assumption by the authorities, the research community and people living in flood-prone areas that flooding occurs only in informal settlements, and that the provision of subsidised housing addresses flood-risk.

This chapter draws together the findings of the research, and the key arguments presented in this thesis. I reflect on how risk, hazard and vulnerability are conceptualised and applied in theory and practice, and interrogate critically prevailing conceptualisations of risk. I challenge prevailing assumptions about the nature of flooding, who is vulnerable, the sources of vulnerability and how risk and vulnerability accumulate and manifest. I argue that, due to an overly narrow framing of flood-risk locally and internationally, prevailing discussions fail to capture the experiences of households in living subsidised housing areas. I also argue that the coarse conceptualisation and application of the concepts of risk, hazard and vulnerability obscures the complex dynamics driving vulnerability on the Cape Flats. In both instances, this prevents a comprehensive understanding of risk, both in Cape Town and in parallel contexts elsewhere. Drawing together these threads, I argue for a broader but more precise conceptualisation of flood-risk and risk more generally. The chapter begins by briefly recapping the conceptualisation of risk in the local and international literature. It then summarises the key findings on flood-risk in subsidised housing areas, before moving on to examine the lessons for how we understand and respond to risk.

Revisiting the problem: Key assumptions in the literature

Discussions on risk and risk reduction conceptualise flood-risk in very specific ways. Flooding is generally seen as a hydrometeorological hazard. Most constructions of flood-risk emphasise its hydrological aspects, and tend to focus on issues such as river flooding, storm surges and coastal flooding due to meteorological triggers such as heavy rain, storms and snow melts (for instance, Guha et al, 2012; Jha et al, 2011; Smith and Petley, 2009; ADPC, 2005a; Hewitt, 1997; Alexander, 1993; 2000), although discussions also include events such as tsunamis triggered by earthquakes, and other non-meteorological hazards (see Smith and Petley, 2009; Hewitt, 1997; Alexander, 1993). Despite the increasing emphasis on extensive as opposed to intensive risk - the potential for harm from small-scale, diffuse, ongoing hazards such as poor environmental health and traffic accidents versus acute, destructive events such as earthquakes - the accent remains on heavy rain or other triggers as

perturbation to a normal or expected state. The focus is on surplus water, in the form of water over-topping a riverbank or channel or inundation of land that is usually dry. This conceptualisation of flooding is heavily influenced by assumptions about flooding within the natural, rural environment (Zevenbergen, 2007), and reflects a more general rural bias in the underpinnings of disaster risk science (Pelling and Wisner, 2009).

An emerging body of research on flooding in urban contexts highlights additional and often unique forms of flooding in urban areas in the developing world. These are linked to features of the urban environment, and include flooding due to run-off from hard surfaces, artificial system failures, such as where waters breach a dam or an embankment fails to protect developments, and overflowing drainage infrastructure (for instance, Fatti and Patel, 2012; Jha et al, 2012; Sakijege et al, 2012; Benjamin, 2008; Action Aid, 2006). Research in the Western Cape adds additional types, including flooding resulting from the expansion of settlements into wetlands, a high water table in low-lying areas, ponding in poorly drained locations, and leaks in poorly constructed roofs, walls and doors (Drivdal, 2011 a-b; Benjamin, 2008; DiMP, 2008; DiMP 2005; DiMP, 2007; Bouchard et al, 2007; Ramutsindela, 2006). This research has served to expand how flooding is conceptualised, but the construction of flooding as a hazard remains largely in the same conceptual realm as more conventional types. Flooding is still viewed primarily as a hydrometeorological hazard. The trigger is rainfall and storms and the problem too much water, or to paraphrase Hewitt (1997), water in the wrong place or at the wrong time.

As discussed in Chapter 2, the research on urban flooding implies a pathway that runs from weather through to inundation. Rain, storms or changes in weather result in waterbodies overflowing, storm surges, run-off from hard surfaces or other types of surplus. Land use dynamics, developmental issues, governance failures and features of the built, urban environment serve, in the terminology of the PAR model, as dynamic pressures that create unsafe conditions such as settlement in flood-prone areas (Wisner et al, 2004; Blaikie et al, 1994). Where these pre-existing vulnerabilities coincide with hazard events, the result is often deaths, injuries and damage to property and infrastructure. These impacts, in turn, contribute to the

accumulation of vulnerability over time (see Wisner et al, 2004; Pelling, 2003; Hewitt, 1997; 1983; Blaikie et al, 1994).

Underlying this construction of causality are a range of assumptions about which people are vulnerable, the sources of vulnerability and the level at which risk accumulates and manifests. The research on urban flooding, for instance, suggests a strong link between poverty and risk (for instance, Action Aid, 2006; United Nations Development Programme, 2004). Commentators frequently argue that it is the poor who are most vulnerable, particularly those living in informal settlements, where dangerous locations, low-quality housing, inadequate or poorly maintained drainage infrastructure and limited service delivery leave them particularly exposed to flood events, and amplify their impact (Action Aid, 2006; Pelling, 2003). Flood-risk also tends to be conceptualised at a collective level (Alwang et al, 2001), the assumption being that whole communities or areas are affected by overflowing rivers, system failures or other hazards.

These assumptions, in turn, reflect larger issues in the conceptualisation of risk. The first is a frequent emphasis on vulnerable groups (Canon, 2008; Wisner, 2001). Most conceptual discussions on vulnerability recognise that it varies over time and space, between individuals and households, and according to the hazard involved (for instance, Wisner and colleagues, 2004; Pelling, 2003; Blaikie and colleagues, 1994; Hewitt, 1983; 1997) but this complexity is often lost in generalisations about 'vulnerable groups'. Instead of exploring the situations and processes that generate vulnerability in particular contexts, discussions often simply focus on 'the poor', those living in 'slums' or informal settlements, or types of people such as single women, the elderly or disabled (Levine et al, 2012; Cannon, 2008; Wisner, 2001). The second conceptual issue is an emphasis on the social parameters of vulnerability. Many commentators recognise that the built environment influences risk (see Mileti and Gailus, 2005; Cardona, 2004; 2003; Wisner et al, 2004; Cutter et al, 2003; Pelling, 2003; Blaikie et al, 1994), but the focus is primarily on the socio-economic and governance issues that drive vulnerability and place, as Cannon (2008) observes, people in the way of hazards. The third issue is a tendency to discuss and apply vulnerability and risk at a covariate level. While the literature often recognises that risk and vulnerability accumulate at the individual and household scale (for instance,

Smith, 2001; Hewitt, 1997) the focus is often on groups or areas – although this assumption is often implicit.

This thesis challenges these assumptions and illustrates a far more complex picture of risk. As discussed in the next section, my research shows that households' experiences of flooding in subsidised housing on the Cape Flats are very different from those suggested in prevailing discussions on flood-risk and risk more broadly. In so doing, it provides new perspectives on the nature of flooding in Cape Town, and the sources of vulnerability. It also challenges assumptions about housing as a solution to risk, and the scale at which risk and vulnerability accumulate and play out.

Transferred and transformed: Summarising the findings on risk in subsidised housing areas

While research and practice tend to situate risk in informal settlements, my research shows that those in informal settlements are also at risk. Although it is assumed that moving people out of informal settlements and into subsidised housing solves flood-risk, they continue to experience flooding. Comparing the experiences of households in informal and subsidised households also shows that they experience these risks at levels comparable to their counterparts in informal settlements. Instead of solving risk, my research shows that risk is transferred and transformed, taking on new characteristics as households make the transition from informal to subsidised housing. The hazard takes on new forms, but persists.

The profile of flooding in informal settlement areas reflects the literature on urban flooding in Cape Town, but flooding in subsidised housing areas is primarily due to structural flaws. Households in informal settlements tend to experience seepage, in which water seeps up through the floor, ponding and run-off and, to a much lesser extent, leaks. In subsidised housing areas, however, the hazard stems primarily from leaks in poorly built walls, cracking in the plaster and concrete around doors and windows, and badly laid or unfinished roofs. Respondents living in subsidised housing areas reported seepage through poorly built floors, but at much lower levels than in informal settlements.

Flooding in formal housing areas seldom results in inundation. While discussions on flooding in Cape Town often conceptualise flooding in terms of flooded dwellings or areas (see for instance, Fatti and Patel, 2012; Drivdal, 2011 a-b; Bouchard et al, 2007), little of the flooding in subsidised housing areas results in flooded dwellings. A small number of households experienced run-off, which, judging by the financial costs incurred, might have resulted in a substantial inflow of water, but ‘flooding’ most often resulted in damp conditions, leading to the growth of mould.

These findings on the nature of the problem – leaks, damp and mould – suggest that the underlying mechanisms that shape risk and vulnerability differ in subsidised housing areas. As discussed further in the next section, rain is not in itself the primary source of harm. Rain plays an integral role in generating risk in informal settlements, but as discussed further below, it is almost incidental in formal housing areas; rain does not have to be heavy or prolonged to penetrate cracks, and once damp and mould take hold they create hazardous conditions that exist irrespective of rainfall – although extensive rain is likely to worsen these impacts.

The findings on the costs incurred by households affected by flooding show that it impacts significantly on households’ resources, particularly in formal settlements. Households in both informal and subsidised housing areas spent money on replacing or repairing property, fixing or improving their dwelling, replacing food and groceries and on medical expenses. Fewer households in formal settlements reported expenditure than in informal areas, but those that did spent more compared to their counterparts living in informal dwellings. While informal households spent an average of almost R 1 000 (US\$ 110) as a result of seepage and run-off, and just over R 500 as a result of leaks (US\$ 56), those in formal dwellings spent an average of R 1 686 (US\$ 190) due to seepage and just over R 1 000 as a result of leaks. Households living in subsidised areas often had more resources available to them than those in informal settlements, but repairing damage, fixing leaks and implementing mitigation measures to mitigate risk is also more costly for those in subsidised housing, with households often needing to spend more as a proportion of their income than those in informal settlements. This spending amounted to as much as 60% of average monthly household income in the case of seepage and 44% in the case of leaks. Households in

informal settlements, by comparison, spent only 54% and 27% their average monthly income respectively.

The research suggests that the costs of both addressing damage and implementing mitigation measures are borne entirely by affected households, potentially increasing the impact of rain-related problems and damage. The findings show that, although some households were able to absorb these costs without a negative impact, they often consumed the resources available to households for everyday expenses, such as food, groceries and utility bills. This has potentially immediate implications for the well-being of household members. In many instances households borrowed money, incurring debts that could also absorb economic resources in the longer term.

The substantial variation in the experience of flooding in subsidised housing areas highlights the frequently variable nature of realised risk. Informal settlements showed similar risk profiles, but the formal areas were far more diverse. Some sites were substantially more likely to experience flooding than others, and even sites adjacent to one another showed different levels and types of problems. Households in Luyoloville, for instance, reported high levels of seepage and run-off, while their neighbours in New Rest reported very little flooding, most of which took the form of leaks or run-off. This suggests that risk is linked to the history of each settlement, including the housing model and the diligence of the developer.

The research provides several examples that illustrate the potential importance of contextual factors. In New Rest, for instance, higher quality buildings have seemingly transformed a flood-prone informal settlement into a relatively low-risk formal one. In Luyoloville, by contrast, substandard dwellings contribute to high levels of flooding. The poor quality of dwellings is primarily due to issues with the developer, the CTCHC, which has been linked to poor building practices in several settlements in Cape Town (Zweig, 2006). The lower levels of flooding in Vukuzenzele compared to Better Life, Luyoloville and Samora Machel may also reflect the difference in process between owner-built (PHP) and contractor-built settlements. The statistical analysis failed to find a consistently strong relationship between housing model and realised risk, but the qualitative research suggests that beneficiaries in Vukuzenzele benefitted from FEDUP's involvement in other housing projects. Although

beneficiaries' limited building skills created challenges, the findings suggest that they gained from FEDUP's expertise on points of design, such as the need for larger roof overhangs and extra brickwork to ensure that the floor slabs were well above ground level. Fewer problems may also indicate better workmanship, as beneficiaries had a vested interest in ensuring that dwellings were well built.

The spatial analysis suggests that levels of risk may also reflect the histories of individual buildings. The experiences of households in informal areas were again similar, but the spatial analysis showed considerable variation within subsidised housing areas, even within highly standardised settlements such as Better Life and New Rest. While one dwelling experienced leaks and seepage, for instance, a neighbouring house experienced just one problem or none at all. This diversity could reflect differences in the skill and attention paid by individual workmen or teams, and suggests that risk accumulates and manifests in very individualised ways in subsidised housing settlements. Slight differences in mortar or plaster-mix, for example, or in thoroughness and patience in letting plaster and concrete dry may affect the integrity of buildings and, as a result, shape risk and its distribution.

These findings highlight the role of the built environment in driving risk. The literature tends to focus on the social drivers of vulnerability – and in the case of conventional flooding, geographical factors such as proximity to waterbodies or topographical features – but the qualitative, quantitative and spatial analyses all point to the role of dwelling design and quality in determining the likelihood of experiencing leaks, seepage and run-off. Layering the data from the three sources shows that, although geography and socio-economic issues have some influence on the likelihood of experiencing flooding, features of built environment play a central role. It is the way that settlements are laid out, dwellings are designed, the care with which houses are built, and how they are finished that have the greatest bearing on who is affected. The findings suggest that risk often comes down to characteristics such as the spacing of dwellings, how far roofs overhang the exterior wall, the materials used and how dwellings are finished.

My research shows that although macro-economic and political issues underpin risk, buildings themselves are important in shaping households' experiences. As discussed

in Chapter 3, settlement patterns on the Cape Flats reflect decades of social and geographical marginalisation, and the continued peripheralisation of subsidised housing. Although not explored extensively in this thesis, the findings also suggest that a range of dynamics within the larger macro-economic and political environment shape design and quality issues. These include inadequate monitoring and oversight, the lower standards to which subsidised housing is held, and limited scope for beneficiaries to hold contractors accountable for poor work. However, while settlements share a marginal physical and social space, they are not uniformly exposed or vulnerable, suggesting that the inequalities structuring life on the Cape Flats only partially explain risk. These are important, but are background issues. In the foreground are building and settlement features. This suggests that although societal issues influence risk, it is the built environment that is central to understanding why some households experience flooding and others do not.

The nature of buildings may also contribute to risk in other, more subtle ways. Home owners in Better Life, for instance, noted that dealing with flooding in informal settlements was easier than in subsidised housing, as people knew how to weatherproof or repair a shack, but not a brick and mortar dwelling. Without realising it, in fact, many households inadvertently increased their risk of damp and mould by painting their walls with hydroscopic Cretestone. While this study did not explore these dynamics in depth, the findings suggest that insufficient knowledge about how to address flooding in formal dwellings might contribute to risk in subsidised housing areas, indicating an area for further research.

Rethinking who, what, why and issues of scale

These findings indicate a complex and multi-dimensional risk environment on the Cape Flats, which challenges prevailing constructions of flood-risk and risk more generally. Returning to the vision of risk and the pathways of cause and effect presented in Chapter 2, the findings suggest a need to revisit how we conceptualise flood-risk and risk in Cape Town. Figure 40 redraws the schematic from the perspective of risk in subsidised housing areas. It shows that the causal pathways are very different to those suggested in the literature. Rain still serves as a trigger, but it is

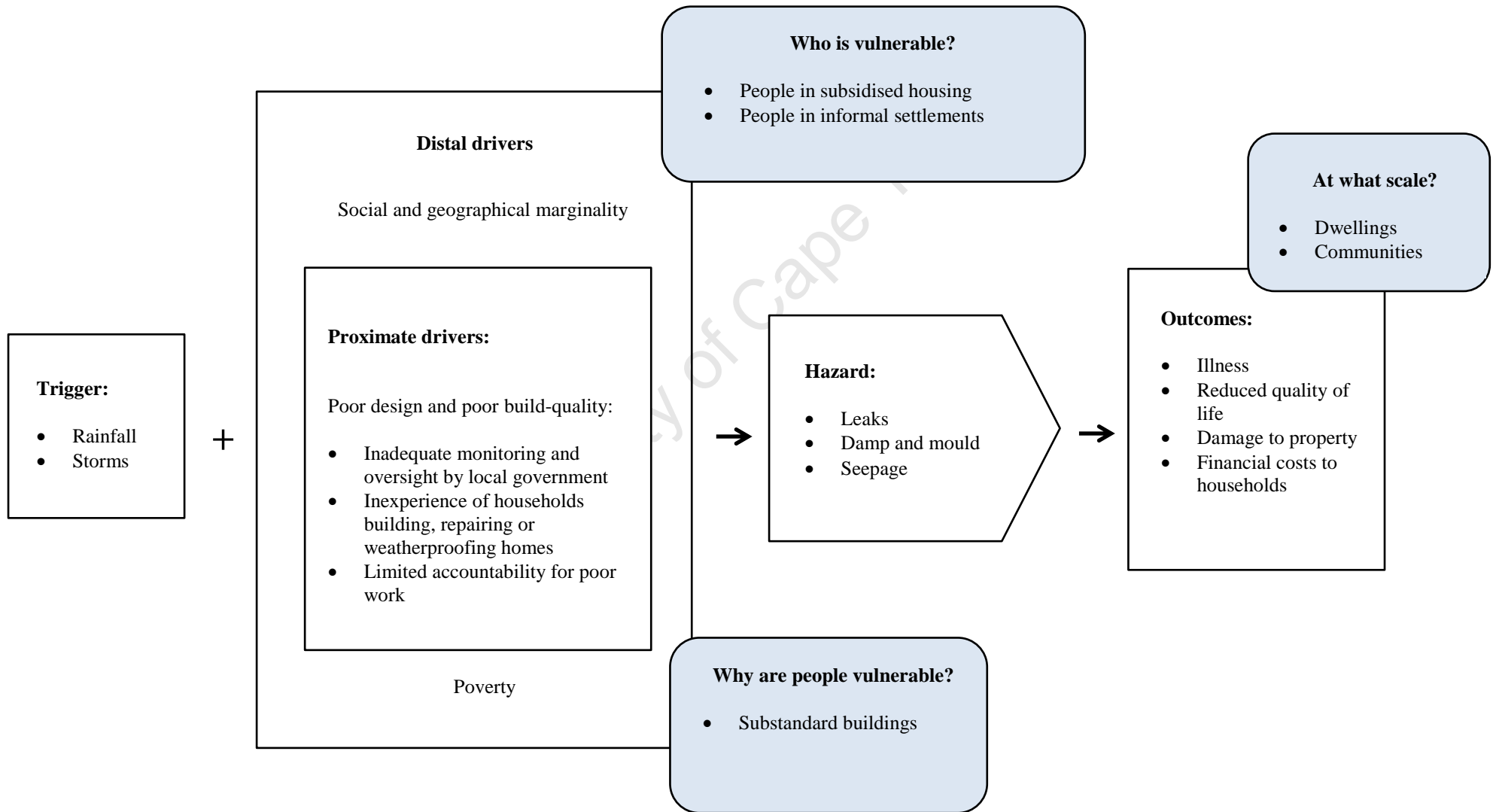
of far less significance overall. Leaks and seepage comprise the main first-generation hazards. These problems are driven primarily by poor design and substandard construction, which in turn, reflect but subordinate broader issues such as inadequate monitoring and oversight, building standards, inexperience and limited levels of accountability. Instead of damage and losses due to inundation, damp and mould impact on households' quality of life and health and damage dwellings and property, suggesting that they constitute second-generation hazards.

The findings also challenge the assumptions underlying prevailing approaches. They show that flood-risk is not confined to informal settlements. Although it is shaped by social factors, it is primarily features of the built environment that drive risk, particularly how settlements are designed and how well dwellings are built. Risk also accumulates and manifests in a highly idiosyncratic manner. Instead of playing out at a collective level, it varies between and within settlements, and often between neighbouring dwellings. I argue that these findings suggest the need for a wider, but more precise conceptualisation of flood-risk in Cape Town. As discussed below, they also highlight conceptual gaps and points of revision in broader discussions on urban flooding and risk. The next section draws out the key issues and points of revision.

The problem with flooding: Revisiting the hazard

The findings show that prevailing constructions of the hazard fail to capture adequately the experiences of people living in subsidised housing in Cape Town. Neither conventional framings of the hazard nor the literature on urban flooding reflect the situation in subsidised housing areas, where the hazard is only weakly linked to weather or hydrology and frequently fails to conform to urban flood typologies. 'Flooding' in subsidised housing is seldom about surplus water. The problem is not flooding due to infrastructural issues or encroachment into flood-prone areas. It is not even primarily about 'rising flooding' or seepage. Rather, it is about cracks and leaks and the resulting damp and mould.

Figure 40: Summary of risk in subsidised housing areas



These findings suggest that narrowly defining the parameters of the hazard excludes an important component of risk on the Cape Flats. By focusing on rainfall and inundation, and pre-determined categories of what flooding involves, we fail to capture fully how flood-risk manifests in the local context. We also discount its impact on households living in subsidised housing areas. This suggests that the hazard needs to be conceptualised differently if we are to capture the experiences of those in formal housing. The emphasis must be not on too much water or water in the wrong place, but rather on the failure to keep water out of dwellings. The primary source of harm is damp and mould, rather than inundation, suggesting that these are important components of the hazard and not just a product of it.

In this sense, the term ‘flooding’ misidentifies and misrepresents the experiences of households living in subsidised housing, and prevents a more comprehensive understanding of the issues. There currently exists no term in the literature that describes adequately the experiences of households living in subsidised housing on the Cape Flats. ‘Flooding’ as a term and, as generally constructed, a concept, does not capture the complex reality illustrated in the case study. This suggests the need for a more expansive naming and conceptualisation of flooding. Rather than ‘flooding’ there is, perhaps, the need for a new phrase such as “rain-related damage” or “rain-related conditions”.

Recognising leaks, damp and mould as hazards has several implications. First, it shifts attention firmly onto the built environment. It is not too much water that causes difficulties for households living in subsidised housing, but as noted above, a failure to keep water out of dwellings. Second, the time-scale widens. ‘Flooding’ manifests less as an acute, short-term disruption to a normal or expected state, and more as a chronic problem. From this perspective, the types of flooding experienced in subsidised settlements fall well within the concept of extensive risks, such as disease, or traffic accidents. Third, it suggests that ‘flooding’ spans a continuum of experience, from acute and potentially destructive intensive events such as river floods or storm surges, to the more mundane damp and mould which, although less lower-key issues, impact profoundly on the households affected. In all three cases, the findings reaffirm the need to think differently about flooding in urban settings.

The invisible people: Revisiting the conceptualisation of who is vulnerable

The findings suggest not only that households in subsidised housing experience rain-related hazards, but that they may be more exposed to problems than those in informal settlements. There needs to be a large volume of rainfall before seepage and run-off become concerns in informal settlements, but as noted already, even light rainfall can be problematic for households in subsidised housing. Moreover, while the hazards in informal areas - seepage and run-off and to a lesser extent leaks in corrugated iron structures - are primarily seasonal in nature and fade with the arrival of summer, damp and mould in brick and mortar walls are persistent year-round problems. Once established, they are often difficult to eliminate, suggesting that the consequences of even a few rainstorms may have long-term impacts.

This suggests a conceptual gap with respect to who is considered vulnerable. The findings suggest that by situating risk primarily in informal settlements, prevailing constructions fail to identify the risk that exists in subsidised housing areas. This prevents a comprehensive understanding of the risk environment. In the South African context specifically, the assumption that only informal settlements experience flooding renders invisible an entire group of people potentially affected by flooding. This neglect of households living in subsidised housing also stands to exclude and marginalise housing beneficiaries, and helps to undermine the developmental objectives of South Africa's subsidised housing programme. This finding is particularly important in the South African context, where subsidised housing is viewed as the key mechanism for both reducing risk and correcting the inequalities of the past.

The findings also suggest an overall bias in how risk is conceptualised. Just as discussions on risk and risk reduction have tended to focus on risk dynamics in rural areas, the case study suggests that there is a bias towards the experiences of households living in informal dwellings. However, while the rural bias is increasingly recognised, the experiences of poor people outside of informal settlements remain largely invisible.

The built environment as a catalyst: Gaps in thinking on the drivers of risk

The findings also suggest a disparity between experiences on the Cape Flats and assumed sources of risk. South African discussions on flooding tend to take either a hydrological or an urban risk perspective. The former emphasises geographical drivers, such as proximity to waterbodies or floodplains, while the latter emphasises the issues driving risk in informal settlements, such as rapid urban expansion, poverty and blockages in service delivery. As noted already, however, neither of these are the primary source of vulnerability in subsidised housing areas. It is not location or service delivery, or even poverty that fundamentally drives risk, but how settlements are designed and dwellings are built.

Both local and international discussions on risk frequently focus on its social dimensions. While living in substandard dwellings exposes households to flooding, for instance, the emphasis is on the developmental and governance issues that lead people to live in unsafe houses (see Wisner et al, 2004; Pelling, 2003; Heijmans, 2001; Hewitt, 1997; Blaikie et al, 1994). Although such larger issues clearly underlie the challenges experienced in subsidised housing areas, this approach again fails to capture adequately the drivers of risk in Cape Town, where the design of settlements and dwellings and quality of housing comprise crucial sources of vulnerability.

Some theorists focus more on the environment as an active component of risk, but these approaches still fail to capture the risk dynamics in subsidised housing areas. Commentators such as Mileti and Gailus (2005), Omar Cardona (2004), Cutter and her colleagues (2003), Pelling (2003) and others place a greater emphasis on the role of the built environment in driving risk, but they tend to focus on the potential for damage. The nuts and bolts of these theories differ, but they have in common a core argument. This is, in essence, that where weak buildings and infrastructure are located in hazard-prone areas, they are more susceptible to damage. Such buildings are either less able to protect their occupants, or in the worst cases, serve to amplify the negative effects of hazards, such as when badly constructed buildings collapse during earthquakes. My research, however, suggests that buildings influence vulnerability in

a far more direct way. It is not that dwellings are less able to withstand heavy rain or severe weather, with negative implications for the people inside, but that pre-existing flaws in the design and construction of dwellings fundamentally drive and amplify risk. In many cases, badly designed and built houses expose households to leaks, seepage and conditions such as damp and mould. They serve to translate low to moderate rainfall – levels of rain that should be easily withstood by brick and mortar structures – into harmful events that impact negatively on households in the short, and possibly longer term.

As discussed in Chapter 7, the findings do not discount the role of macro-level factors, but rather suggest the need for a shift in emphasis and perspective. While issues of design and quality are linked to macro-political and socio-economic dynamics, including those that create an environment conducive to corner-cutting and substandard construction, the core drivers of risk lie in the built environment. Instead of seeing weak buildings as the product of macro-economic, political and governance processes, the analysis suggests that buildings need to be considered active drivers of risk. As in the literature on seismic risk, the findings suggest that poor design and construction need to be understood as central to the conceptualisation and construction of risk in subsidised housing areas. Just as discussions on seismic risk explore how the siting, shape and design and other technical factors influence risk (see for instance, Hosseini, 2007; Arammepola, 2007; Anbarci et al, 2005; Alexander, 2000), my research suggests a need to approach flood-risk from both a social and physical perspective. The findings suggest that discussions on flooding need to incorporate issues such as building standards and adherence to building codes. They also suggest scope for greater attention to weather and rain-resistant design and construction techniques.

Idiosyncratic versus covariate risk: Rethinking issues of scale

The highly idiosyncratic nature of risk in subsidised housing areas also suggests the need for a different perspective. Although discussions on flooding do not always take an explicit position on scale, most imply that risk occurs at a collective, or covariate level. The assumption is that flooding affects groups of people or whole communities,

usually by virtue of their location. In the case of hydrological explanations, the emphasis is on catchments, and the location of settlements and infrastructure in floodplains or areas likely to experience flooding. In urban-risk explanations, the focus is on ‘informal settlements’ as a whole, or particular areas at risk, such as those near to watercourses or drainage ditches. However, the very high levels of variability between and within settlements in the case study suggest that broad brush-strokes are insufficient for understanding the risk patterns in subsidised housing areas.

These findings highlight the dangers of oversimplifying how risk accumulates and manifests and suggest the need for a more nuanced approach. While it makes sense to conceptualise more conventional forms of flooding in covariate terms, people’s diverse experiences in subsidised housing areas indicate that conceptualising risk in too coarse a manner prevents a comprehensive understanding of risk in formal areas. The findings also suggest that ‘flooding’ on the rain-related conditions side of the flood-risk continuum is better conceptualised in a more idiosyncratic way. Vulnerability plays out between households, and needs to be understood and examined at the level of, as Hewitt (1997) observes, micro-organisation and micro-politics.

From vulnerable groups to hazardous conditions: Vulnerability as state rather than characteristic

The findings suggest a need for greater precision in how we conceptualise vulnerability. The research suggests a tendency to apply the concepts of risk and vulnerability heavy-handedly. Many discussions on risk recognise conceptually that risk varies according to the hazard, time and location (for instance, Field et al, 2012; Gaillard, 2010; Vogel and O’Brien, 2004, cited in Birkmann, 2006a; Wisner, 2004; Blaikie et al, 1994). In practice, vulnerability is frequently conflated with ‘the vulnerables’ (Holloway, personal communication, August, 2012). Discussions on social vulnerability tend to translate into what Wisner (2001) terms laundry list taxonomies of vulnerable groups, such as women, children, the elderly or the disabled or, in the case of Cape Town, vulnerable people in informal settlements. My findings suggest that focusing on vulnerable groups risks overlooking the vulnerability of

people falling outside of these groups. As discussed further below, it also obscures the dynamics driving vulnerability, and ignores critical additional causal chains and alternative manifestations of risk.

The issues of scale also suggest that focusing on vulnerable groups, or any other group, prevents accuracy in the conceptualisation of risk. For instance, it is clear that households living in subsidised housing experience flooding, but levels of realised risk vary between households. Due to the attributes of individual dwellings, not everyone experiences flooding, or even the same types of flooding. This suggests that it is insufficient to discuss risk in generic terms. Instead of making broad generalisations about vulnerable housing types, it is necessary to examine the particular characteristics of structures, in this case dwellings, that increase vulnerability.

These findings also link to discussions around the location of vulnerability. Households' highly individualised experiences in subsidised housing suggest that the vulnerability is mediated by the histories of settlements and dwellings, particularly who built them. Vulnerability in this instance is rooted in individual dwellings. This is very much in line with Cutter's hazards-of-place model, which argues that vulnerability is place-specific. Cutter and colleagues (Cutter et al, 2003) argue that social vulnerability is the product of social inequalities that may exist at a range of scales, but that it is also linked to the specific dynamics. These comprise the characteristics of communities and the built environment in which they live that mediate their vulnerability to hazards at any particular time. These include levels of urbanisation, growth rates and economic vitality.

However, the highly differentiated nature of risk suggests that the hazards-of-place concept needs to be taken one step further. The findings indicate that risk and vulnerability are not only linked to specific places, but that they are embedded in the specific histories and features of individual dwellings. From this perspective, levels of risk and vulnerability may be transitory, not only changing over time as the dynamics of particular places change, but also as people move in and out of particular dwellings or settlements – or undertake measures to repair the cracks and weaknesses that result in leaks or seepage.

These findings link to broader debates around the temporal aspects of vulnerability. Discussions often construct vulnerability as a characteristic, but many argue that it is not a steady state; people become more or less vulnerable depending on the particular dynamics at play at any given time (for example, Hilhorst and Bankoff, 2004, Cardona, 2004, Cutter and colleagues, 2003). Dorothea Hilhorst and Greg Bankhoff (2004), for example, argue that vulnerability is not a property of social groups and individuals, but is embedded in complex social relations and processes. Pelling (2003) argues that vulnerability is mediated by people's ability to cope at a given moment. As Burg (2008) notes, people are not just vulnerable, they are vulnerable to something – what this is may change.

In line with these arguments, the findings suggest that risk and vulnerability are not constant. Vulnerability in subsidised housing is best understood not as a property of social groups or individuals, but as a condition linked to physical, social, economic and environmental factors that condition people's experiences at a particular moment in time. The variation between and within settlements also highlights the importance of focusing on the root causes of vulnerability – low-quality housing – and the specific bundle of factors that shape build-quality in particular settlements or dwellings. As with discussions on food security, in which vulnerability analysis focuses on understanding micro-level dynamics (Burg, 2008), the results suggest that the emphasis must be on determining which people are more vulnerable, and what makes them vulnerable.

A broader, more precise, concept of risk

The findings presented in this chapter suggest that there is frequently a disjuncture between constructions of flood-risk and people's experiences in subsidised housing areas in Cape Town. Discussions on flooding and risk more broadly focus on informal settlements, the social dimensions of vulnerability and flooding as a covariate issue. The hazard is also conceptualised in very specific ways. Flooding is primarily triggered by heavy rainfall, storms or other meteorological phenomena, and manifests

as too much water, and the flow of water into areas that should be dry. My findings challenge these assumptions. They show that flooding is not confined to informal settlements. They illustrate that flooding in subsidised housing is not about severe weather, or too much water, but rather substandard dwellings that allow rain, potentially even at low and moderate levels, into dwellings. It manifests not as inundation but as damp and mould, which constitute the primary sources of harm. Vulnerability is rooted primarily in features of the built environment that expose households to rain-related problems and accumulates and plays out at a micro-scale.

This thesis shows that prevailing constructions of risk fail to capture the dynamics in Cape Town. The narrow framing of risk locally and internationally conceals the ongoing risk in subsidised housing settlements. This serves to marginalise vulnerable households in poor formal areas and helps to undermine the developmental objectives of the subsidised housing programme. At the same time, the blunt conceptualisation of vulnerability and risk obscures the complex dynamics driving vulnerability. By focusing on 'vulnerable' informal settlements and at-risk groups, we fail to capture both the range of experience in Cape Town and processes making people vulnerable to flooding. In both instances, this prevents a comprehensive understanding of risk, both in Cape Town and more broadly.

The findings suggest, I argue, the need for a shift in how we conceptualise risk. While the literature on urban flooding has extended how it is conceptualised, the findings indicate the need for an even wider conceptualisation of the hazard that encompasses issues such as leaks and conditions such as damp and mould. There needs to be greater emphasis on the experiences of poor households outside of informal settlements. I argue that discussions on flooding locally and in parallel contexts elsewhere also need to examine the contribution of the built environment, and the role of dwellings in particular, in driving risk. They also need to explore the processes driving risk in particular places, including the micro-level dynamics influencing risk within communities and between households.

The next chapter draws out these key issues and their implications. It brings together the primary conclusions emerging from the study, and draws out the central

theoretical arguments. It also identifies continuing gaps and areas for future research, and makes recommendations for theory and practice locally and more broadly.

CHAPTER 9

Deepening discussions on urban flooding and risk

Challenging assumptions about risk

Discussions on the dangers of flooding, and risk more broadly, are often based on a range of assumptions. These include suppositions about what flooding involves, what drives flood-risk, who is most vulnerable and the scale at which flood-risk manifests and impacts. Flooding is typically considered a hydrometeorological hazard and has historically been viewed primarily as a hydrological issue. This thesis sought to test these assumptions about risk. Taking as its starting point the constructionist idea that the conceptualisation of risk is shaped by the worldview of those discussing and using the concept, it aimed to interrogate how risk and the related concepts of hazard and vulnerability, are conceptualised in the literature, and how effectively these constructions capture people's experiences of urban flooding in a contemporary urban setting. Using flood-risk in subsidised housing in Cape Town as a case study, the thesis examined how well the local experience of flooding conforms to prevailing assumptions about 'flooding' as a hazard and its consequences for affected households.

The thesis examined specifically the chain of causality implied in international and local discussions on flooding. It explored whether flooding is primarily an issue of surplus water, triggered by atmospheric conditions, and whether it results in inundation, human losses and damage to property and infrastructure. With reference to Cape Town specifically, I aimed to fill the gap that exists in knowledge about the extent and nature of flooding in subsidised housing. I also sought to test empirically the assumption by the authorities, the research community and people living in flood-prone areas that flooding occurs only in informal settlements, and that the provision of subsidised housing addresses flood-risk. In addition to who is vulnerable, the thesis

also examined the nature of flooding in Cape Town, the drivers of vulnerability and the scale at which risk accumulates and manifests.

In so doing, the thesis makes several contributions to international and South African discussions on flood-risk, and risk more broadly. It augments discussions on risk, particularly the discourse on risk in urban areas, by interrogating how well prevailing constructions capture the experiences of poor households in urban areas in developing countries. It also contributes to the emerging body of research on flood-risk in urban environments. Finally, it enables better analysis of the parameters of flood-risk in Cape Town, and fills the research gap that exists with respect to the extent, nature and impact of flooding on households in subsidised housing areas.

Additional perspectives on urban flooding and risk

The thesis demonstrates that there is frequently a disjuncture between prevailing constructions of risk, and flood-risk specifically, and the lived experiences of people in subsidised housing areas in Cape Town. International theory and both domestic theory and practice, in particular, tend to focus on risk in informal settlements, but the findings show that those in subsidised housing areas also experience flooding, suggesting a significant conceptual gap in the conceptualisation of risk, locally and more broadly. Although the provision of a formal, brick and mortar dwelling is widely viewed as a solution to flood-risk, the research shows that flooding is a concern in subsidised housing areas. Rather than being eliminated, the findings show that risk is transferred and transformed, taking on new characteristics as households make the transition from informal to subsidised housing. The issue shifts from 'flooding' to leaks and the resulting damp, mouldy conditions, but the hazard persists.

The findings also challenge assumptions about the nature of flooding. Prevailing approaches most often conceptualise flooding as an acute, short-term surplus of water triggered by rainfall or storms. Discussions frequently focus on its hydrological aspects, such as riverine flooding or storm surges, or in urban areas, problems such as overflowing drainage infrastructure, run-off from hard surfaces or seepage. Flooding

in subsidised housing areas, however, is quite different. It is generally neither strongly linked to weather nor hydrology, and is seldom due to overflowing drains or other features of the urban environment. Rather, 'flooding' is due to cracks and leaks in poorly constructed dwellings and results in endangering mouldy and damp conditions rather than inundation. While rainfall may initially trigger damage, it is not a major concern overall. Even moderate to low levels of rain can penetrate cracks and contribute to damp and mould. Damp and mould are also persistent problems that continue to affect dwellings well beyond the lifespan of single storms, severe weather events or even rainy seasons, becoming a serious and chronic problem that may last months or years.

The thesis suggests too a mismatch between experiences on the Cape Flats and thinking on the sources of vulnerability. While discussions on flooding focus on geographical factors, or the social construction of risk, the study shows that vulnerability in Cape Town also has a crucial built environment component. Technical issues such as the way settlements are planned, how dwellings are designed and the quality of construction play an instrumental role in determining whether households experience leaks, seepage or run-off. Although urban expansion on the Cape Flats reflects decades of marginalisation, and issues of design and quality are linked to macro-political and socio-economic dynamics that both create an environment conducive to corner-cutting and substandard construction and limits the extent to which households are able to demand improvements, the research suggests that the drivers of risk lie first and foremost in the built environment. Poor design and quality are not one component of vulnerability, driven by a range of wider political and socio-economic issues; instead, they fundamentally drive risk, suggesting that these factors need to be factored into how we understand risk in subsidised housing areas in a more direct way.

My research also provides additional perspectives on the issue of scale. While current approaches to flood-risk often conceptualise risk at a collective level, the research suggests that flooding is better discussed at the scale of individual households and housing projects, in other words, in idiosyncratic terms. It shows that vulnerability and risk accumulate and play out in highly variable ways in subsidised housing areas. There were frequently marked differences in the experiences of households within

settlements as well as between adjacent settlements. In many instances, dwellings close to one another showed different levels and types of problems, suggesting that risk frequently operates at a micro-scale. In consequence, it is frequently difficult to talk in general terms about flooding in subsidised housing areas, suggesting that risk needs to be understood at a finer scale. It is necessary to examine the dynamics shaping risk in particular households and communities.

Lastly, the research suggests that it is important to understand and to conceptualise vulnerability and risk as a dynamic, rather than a static property of individuals or groups. Linked to the point above, I argue that vulnerability and risk are not constants, but vary over time as people's circumstances change. The findings show that vulnerability in formal housing areas has important temporal aspects, linked very concretely to the histories and characteristics of particular settlements and dwellings. Levels of vulnerability vary as people move in and out of dwellings or settlements or implement measures to mitigate rain-related damage. Vulnerability in subsidised housing is thus best understood not as a property of social groups or individuals, but a condition linked to physical, social, economic and environmental factors that condition people's experiences at particular moments and periods in time. The variation between and within settlements also highlights the importance of focusing on the root causes of vulnerability and the specific bundle of factors that shape build-quality in particular settlements and dwellings.

Overall, these findings suggest that prevailing approaches fail to capture the experiences of households in subsidised housing. Neither the construction of the hazard, nor common positions on the drivers of vulnerability mesh adequately with the empirical realities of people living in formal housing on the Cape Flats. By focusing on rainfall and inundation, and pre-determined categories of what flooding involves, we fail to capture fully how flood-risk manifests in the local context, and discount its impact on households living in subsidised housing.

Conclusion

My research fills an important gap in discussions on flood-risk in South Africa. The research stands alongside Benjamin's (2008) and DiMP's (2003) studies on flooding in subsidised housing on the Western Cape, and helps to shed light on the largely invisible issues and challenges faced by households living in subsidised housing areas. With respect to Cape Town specifically, the research represents the first attempt to understand the nature, extent and impact of flooding on poor formal households, and challenges directly prevailing assumptions about risk in the city. The research spotlights a neglected constituency that has been entirely excluded from both the conceptualisation of flood-risk and sources of help and support. In so doing, it not only extends the framing of risk in Cape Town and South Africa more broadly, it provides an opportunity to develop a more inclusive response to flooding, that includes vulnerable people living in subsidised housing.

These findings add conceptually to discussions on flood-risk more broadly. They suggest several gaps in prevailing discussions, and suggest additional ways of thinking about risk. These gaps in prevailing discussions include the experiences of poor households outside of informal settlements, and flood-risk in poor but formal areas. While research on urban risk and urban flooding, in particular, has helped to deepen knowledge on flood-risk in informal settlements in cities and towns in developing countries, we know less about flooding outside of these areas. This thesis begins to fill this gap. The findings also provide new perspectives on both urban flood-risk and risk in comparable settings in the developing world.

The findings suggest that prevailing framings of flood-risk, and risk more generally, fail to capture the full spectrum of experience in contemporary urban environments. Discussions on risk frequently focus on informal settlements (Drivdal, 2011 a-b; DiMP, 2009a-c; Ziervogel and Smit, 2009; DiMP, 2008; DiMP, 2007; Bahry, 2007; Bouchard et al, 2007; Action Aid, 2006; Pelling, 2003) but the results illustrate that risk is not confined to informal settlements or other areas deemed 'slums'. Moreover, although constructions of risk often frame 'flooding' as either a hydrological issue or a developmental one rooted in poverty and other challenges, the scope of rain-related

damage expands well beyond ‘flooding’ as either a hydrological or developmental event (see Guha et al, 2012; Sakijege et al, 2012; Jha et al, 2011; GAR, 2009; Smith and Petley, 2009; Benjamin, 2008; Pelling and Wisner, 2008; ADPC, 2005a; Pelling, 2003; Hewitt, 1997; Alexander, 1993; 2000). Instead, my research suggests that a continuum of flood-risk exists in urban areas. This spans acute and potentially destructive intensive events such as riverine floods to the lower key, chronic hazardous conditions of damp and mould that undermine household well-being on a daily basis. These conditions are shaped by social conditions, but are rooted in features of the built environment.

The thesis also suggests that an overly narrow framing of flood-risk prevents a more comprehensive understanding of the dynamics at play. I argue that focusing on rainfall, inundation and pre-determined categories of what flooding involves and who is vulnerable limits our understanding of flood-risk. Ring-fencing the conceptualisation of flooding obscures the vulnerability that exists outside of informal settlements or ‘vulnerable’ groups, ignoring critical additional causal chains and alternative manifestations of risk. In this sense, the term ‘flooding’ is constraining, and implicitly limits what can and cannot be included. This suggests perhaps, the need for a new phrase such as “rain-related damage” or “rain-related conditions”, as is used in this thesis.

I argue that the findings also suggest coarseness in the conceptualisation and application of risk as a concept. Although theoretical discussions frequently recognise the often complicated and highly individualised nature of risk (for instance, Field et al, 2012; Gaillard, 2010; Vogel and O’Brien, 2004, cited in Birkmann, 2006a; Wisner et al, 2004; Blaikie et al, 1994), the case study suggests that the concepts of risk and vulnerability are often bluntly conceptualised and applied in the South African and international literature. In line with the arguments by Levine and colleagues (2012) and Cannon (2008), I argue that these nuances are often lost in generalisations about who is vulnerable and the drivers of vulnerability. This obscures the complex, often highly individualised, dynamics driving risk and prevents, I argue, precision in how we understand and respond to risk in urban environments in the developing world.

I argue that we need to think differently about flood- and rain-related risk in urban South Africa, and in parallel contexts elsewhere. The extent, nature and impact of 'flooding' in subsidised housing settlements motivates for a more expansive concept of flooding that encompasses leaks in poorly built dwellings, as well as seemingly banal outcomes such as damp and mould. The suggested role of design and build-quality in driving risk indicates that buildings need to be factored into the conceptualisation of risk. As with discussions on seismic risk (for instance, Smith and Petley, 2009; Hosseini, 2007; Arammbebola, 2007; Anbarci et al, 2005; Alexander, 2000), the findings indicate that poor design and construction are central to the conceptualisation and construction of risk in poorer formal areas. Rather than seeing weak buildings as the product of socio-political and economic processes, the analysis suggests that buildings need to be considered active drivers of risk.

The importance of the built environment in understanding risk also highlights potential sources of risk reduction. While addressing macro-scale societal issues underpinning vulnerability is extremely difficult, the importance of design and quality issues, in this instance, suggests that it is infinitely possible to reduce flooding in subsidised housing areas. The findings illustrate that well-designed, well-constructed housing does address flood-risk, suggesting that greater attention to weather-resistant design and quality would largely address flooding in subsidised housing areas. Although the research shows that capacity constraints in local government pose a challenge to oversight and monitoring in the subsidised housing sector, the findings show that it is possible to reduce flood-risk through existing mechanisms and processes.

There also needs to be a greater focus on the factors that drive risk. The variation between and within sites suggests that vulnerability and risk accumulate and manifest at a micro-scale, and highlights the need for precision in how we understand and discuss risk. This argument underscores the dangers of oversimplifying the conceptualisation of risk and emphasises the need for research that considers the specific drivers of risk in particular places and dwellings. Instead of falling back on generic categories of the 'vulnerable', I argue that the emphasis must be on determining which people are more vulnerable, and what it is that makes them vulnerable.

The thesis also suggests avenues for additional research. These include further examination of the macro-level dynamics impacting on the quality of subsidised housing, and ways to address blockages. While the research examined the role of governance issues, such as the resources available to the programme and capacity constraints in local government, and touched on building standards as factors influencing building design and quality, it did not examine these complex and multi-dimensional issues in depth. However, given the potential for improved monitoring and oversight, and more weather-resistant design to address flood-risk in subsidised areas, the findings suggest value in understanding these dynamics more fully. Key areas for additional research include prevailing monitoring and inspection protocols, the extent to which these are followed, the factors constraining supervision and oversight and how these can be addressed. Linked to this, the research suggests scope for research into the value, feasibility and cost-benefit of introducing weather-resistant design features into subsidised housing, such as larger roof overhangs, guttering and cavity walls. There is also scope for research into how well equipped housing beneficiaries are to reduce their levels of risk, and the extent to which a lack of knowledge about how to address flooding in formal dwellings contributes to risk. Finally, the findings suggest value in exploring the impact of damp and mould, particularly their health implications. There is very little information available on precisely how damp and mould impact health. The available literature makes only superficial reference to the likelihood of asthma, respiratory illness and other diseases, but little explores these in greater detail. This suggests a need for research into precisely how damp and mouldy conditions impact on people's health, the financial and other implications for households, the timescales involved, and strategies for ameliorating their impact.

REFERENCES

Books and articles

Action Aid International (2006) *Unjust Waters: Climate Change, Flooding and the Protection of Poor Urban Communities – Experiences from six African countries*. Available at [www.actionaid.org/assets/pdf/UnjustWaters5HI%20\(2\).pdf](http://www.actionaid.org/assets/pdf/UnjustWaters5HI%20(2).pdf), accessed October, 2007.

Adlard, G. (2008). 'An Introduction to Philippi'. Unpublished paper.

Agrément South Africa (2002a). 'Performance Criteria for Water Penetration and Damp-Proofing'. *Performance Criteria: Building and walling systems*. Board of Agrément South Africa: Pretoria (Tshwane).

Agrément South Africa (2002b). Performance Criteria for Condensation. *Performance Criteria: Building and walling systems*. Board of Agrément South Africa: Pretoria (Tshwane).

Aigbavboa, C. and Thwala, W. (2011). 'Housing Experience of South African Low-Income Beneficiaries'. *The Built and Human Environment Review*, vol. 4.

Alexander, D (1993). *Natural Disasters*. UCL Press: London.

Alexander D (2000). *Confronting Catastrophe: New perspectives on natural disasters*. Oxford University Press: New York.

Alwang, J., Siegel, P. and Jorgensen, S. (2001). Vulnerability: A view from different disciplines. *Social Protection Discussion Paper Series*, no. 0115, Social Protection Unit, World Bank: Washington DC.

Anbarci, N., Escaleras, M. and Register, C. (2005). 'Earthquake Fatalities: The interaction of nature and political economy'. *Journal of Public Economics*, vol. 89, pp. 1907-1933.

Arammbepola, N. (2007). 'Ensuring Safer Shelter and Infrastructure in Urban Built Up Areas'. *Asian Disaster Management News*, vol. 13, no. 2.

Armitage, N., Beauclair, R., Ashipala, N. and Speigel, A. (2010). 'Draining the Shantytowns: Lessons from Kosovo informal settlement, Cape Town, South Africa'. *Proceedings 7th Novatech 2010 International Conference*, Lyon, France.

Arton-Powell, P. (2006) 'Strategies to Mitigate Possible Mudslides and Flooding Following the Fires on the Mountain Slopes in January and February'. Unpublished paper presented to the 2006 Disaster Risk Science honours class, University of Cape Town.

Asian Disaster Preparedness Centre (ADPC) (2005a). *Integrated Flood Risk Management in Asia*. Asian Disaster Preparedness Centre: Hong Kong.

Asian Disaster Preparedness Centre (ADPC) (2005b). *Primer for Disaster Risk Management in Asia*. ADPC: Bangkok.

Bahry, M. (2007). *The Relationship Between Household Livelihood Profile and Fire and Flood-Related Vulnerability*'. Honours Thesis, University of Cape Town.

Barbat, A. (2003). 'Vulnerability and Disaster Risk Indices from Engineering Perspective and Holistic Approach to Consider Hard and Soft Variables at Urban Level'. Input paper for the *Informational and Indicators Programme for Disaster Risk Management* project.

Benjamin, A. (2008). *Analysing Urban Flood Risk in Low-Cost Settlements of George, Western Cape, South Africa: Investigating Physical and Social Dimensions*. Master's Thesis, University of Cape Town.

Benson, C. and Twigg, J. (2007). *Tools for Mainstreaming Disaster Risk Reduction: Guidance notes for development organisations*. ProVention Consortium: Geneva.

Bilham, R. (2012). 'Societal and Observational Problems in Earthquake Risk Assessments and Their Delivery to Those Most at Risk'. *Tectonophysics*, doi:10.1016/j.tecto.2012.03.023.

Birkmann, J. (2006a). 'Measuring Vulnerability to Promote Disaster Resilient Societies: Conceptual frameworks and definitions'. In Birkmann, J. (ed.) *Measuring Vulnerability to Natural Hazards*. United Nations University Press: Tokyo, New York and Paris.

Birkmann, J. (2006b). 'Indicators and Criteria for Measuring Vulnerability: Theoretical bases and requirements'. In Birkmann, J. (ed.) *Measuring Vulnerability to Natural Hazards*. United Nations University Press: Tokyo, New York and Paris.

Blaikie, P., Cannon, T., Davies, I. and Wisner, B. 1994. *At Risk: Natural hazards, people's vulnerability and disasters*. Routledge: New York

Bohl, H-G. (2001). 'Vulnerability and Criticality: Perspectives from social geography'. *IHDP Update 2/2001*, Newsletter of the International Human Dimensions Programme on Global Change, pp. 1-7.

Bolnick, A. (2009). *Informal Settlement Upgrading: Towards a people-centred incremental approach*. Student research paper, Housing Development and Management programme, Lund University. Available at www.hdm.lth.se/fileadmin/hdm/alumni/papers/SDD_2009_242b/Andrea_Bolnick_-_South_Africa.pdf, accessed August 2011.

Boraine, A., Crankshaw, O., Engelbrecht, C., Gotz, G., Mbnaga, S., Narsoo, M. and Parnell, S. (2006). The State of South African Cities a Decade after Democracy. *Urban Studies*, vol. 43, no. 2, pp. 259-284.

Bosher L.S. and Dainty A.R.J. (2011) 'Disaster Risk Reduction and 'Built-In' Resilience: Towards overarching principles for construction practice', *Disasters: The Journal of Disaster Studies, Policy and Management*, vol. 35, no.1, pp. 1-18.

Bouchard, B., Goncalo, A., Susienka, M., and Wilson, K. (2007). *Improving Flood Risk Management in Informal Settlements of Cape Town*. Bachelors Thesis, Worcester Polytechnic Institute, Worcester.

Briguglio, L. (2003). 'Methodological and Practical Considerations for Constructing Socio-Economic Indicators to Evaluate Disaster Risk'. Input paper for the *Informational and Indicators Programme for Disaster Risk Management* project.

Browne, E. (2013). 'Impact of extensive disasters'. *GSDRC Helpdesk Research Report*, no. 1016. University of Birmingham: Birmingham.

Bull-Kamanga, L., Diagne, K., Lavell, A., Leon, E., Lerise, F., MacGregor, H., Maskrey, A., Morissey, J., Pelling, M., Reid, H., Satterthwaite, D., Songsore, J., Westgate, K., and Yitambe, A. (2003). 'From Everyday Hazards to Disasters: The accumulation of risk in urban areas'. *Environment and Urbanisation*, vol. 15, no. 1.

Burg, J. (2008). 'Measuring Populations' Vulnerabilities for Famine and Food Security Interventions: The case of Ethiopia's Chronic Vulnerability Index'. *Disasters*, vol. 32, no. 4, pp. 609-630.

Cannon, T. (2008). 'Vulnerability, 'Innocent' Disasters and the Imperative of Cultural Understanding'. *Disaster Prevention and Management*, vol. 17, no. 3, pp. 350-357.

Cannon, T. (2003) 'Vulnerability Analysis, Livelihoods and Disasters Components and Variables of Vulnerability'. Input paper for the *Informational and Indicators Programme for Disaster Risk Management* project.

Cardona, O. (2011). 'Disaster Risk and Vulnerability: Concept and measurement of human and environmental insecurity'. In Brauch, H., Spring, U., Spring, C., Grin, J.

and Kameri-Mbote, P. (eds.). *Coping with Global Environmental Change, Disasters and Security: Threats, challenges, vulnerabilities and risks*. Springer: Berlin.

Cardona, O. (2004). 'The Need for Rethinking the Concepts of Vulnerability and Risk from a Holistic Perspective: A necessary review and criticism for effective risk management'. In Hilhorst D. and Bankoff G. (eds.). *Mapping Vulnerability: Disasters, development and people*. Earthscan: London.

Carreno, M-L., Cardona, O. and Barbat, A. (2007). 'Urban Seismic Risk Evaluation: A holistic approach. *Natural Hazards*, vol. 40, no.1, pp. 137-172.

Chambers, R. (1983). *Rural Development: Putting the last first*. Longman: Essex.

Chambers, R. (1989) 'Editorial Introduction: Vulnerability, coping and policy'. *IDS Bulletin* vol. 20, no. 2: pp. 1-7

Charlton, S. (2009). Housing for the Nation, the City and the Household: Competing rationalities as a constraint to reform? *Development Southern Africa*, vol. 26, no. 2, pp. 301-315.

Chrisman, N. (2002) *Exploring Geographic Information Systems* (2nd edition). John Wiley and Sons: New York.

Coetzee, E (2002). 'Urban Vulnerability: A conceptual framework'. In *Urban Vulnerability: Perspectives from South Africa*. Peri-Peri Publications: Cape Town.

Cutter, S., Boruff, B., and Shirley, L. (2003). 'Social Vulnerability to Environmental Hazards'. *Social Science Quarterly*, vol. 84, no. 2.

Davis, I. (2004). 'Progress in Analysis of Social Vulnerability and Capacity'. In Hilhorst D. and Bankoff G. (eds.). *Mapping Vulnerability: Disasters, development and people*. Earthscan: London.

Development Action Group (2003). 'Kanana Project, Sebokeng, Gauteng'. *People's Housing Process: Good practice case studies*. Development Action Group: Cape Town.

Del Mistro, R. and Hensher, D. (2009). 'Upgrading Informal Settlements in South Africa: Policy, rhetoric and what residents really value'. *Housing Studies*, vol. 24, no. 3, pp. 333-354.

Diagne, K. (2007). 'Governance and Natural disasters: Addressing flooding in Saint Louis, Senegal'. *Environment and Urbanization*, vol. 19, pp. 555-565.

Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) (2003). 'March 2003 Cut-off Low: Consolidated Report'. Report prepared for the Department of Social Services and Poverty Alleviation of the Provincial Government of the Western Cape, University of Cape Town.

DiMP (2005). 'August 2004 Severe Storm: Post Flood Assessment', report prepared for the Prepared for Catchments, Stormwater and River Management Directorate, City of Cape Town. DiMP: Cape Town

DiMP (2007). 'Severe Weather Compound Disaster: August 2006 cut-off lows and their consequences in the Southern Cape, South Africa', report prepared for the Provincial Disaster Management Centre and the Department of Transport and Public Works. DiMP: Cape Town.

DiMP (2008). *Weathering the Storm: Participatory risk assessments for informal settlements*. DiMP: Cape Town.

DiMP (2009a). *Report of a Community Risk Assessment Undertaken in DiMP students in Collaboration with Urban Matters and the Philippi Youth Forum*, DiMP: Cape Town.

DiMP (2009b). *Community Risk Assessment Report: Never-Never and Phola Park, Philippi, Cape Town*. DiMP: Cape Town.

DiMP (2009c). *Community Risk Assessment Report: Sweet Home Farm*. DiMP: Cape Town.

Dixon, J. and Ramutsindela, M. (2006). 'Urban Resettlement and Environmental Justice in Cape Town'. *Cities*, vol. 23, no. 2, p. 129–139.

Downing, T. (2005). 'Integrating Social Vulnerability into Water Management'. *NeWater Working Paper no. 5*. Stockholm Environment Institute: Oxford.

Drivdal, L (2011a). 'Report on flooding in the informal settlement, 'The Graveyard Pond', Philippi, Cape Town, 2010 – 2011'. Report prepared for the Flooding in Cape Town under Climate Risk" (FliCCR) project, University of Cape Town.

Drivdal, L (2011b). 'Report on flooding in the informal settlement, 'Egoli', in Philippi / Schaapkraal, Cape Town, 2010 and 2011'. Report prepared for the Flooding in Cape Town under Climate Risk" (FliCCR) project, University of Cape Town.

Dodman, D., Hardoy, J. and Satterthwaite, D. (2009). *Urban Development and Intensive and Extensive Risk*, paper prepared for the UNISDR's Global Assessment Report on Disaster Risk Reduction. United Nations: Geneva.

Elson, D. (1991). 'Male Bias in the Development Process: An overview'. In Elson, D. (ed.), *Male Bias in the Development Process*. Oxford University Press: Oxford.

Faling, J., Tempelhoff, W. and van Niekerk D. (2012): 'Rhetoric or action: Are South African municipalities planning for climate change?' *Development Southern Africa*, vol. 29, no. 2, pp. 241-257.

Fatti, C. and Patel, Z. (2012). 'Perception and responses to urban flood risk: Implications for climate change', *Applied Geography*, in press.

Feinstein International Centre (no date). 'Examining the Linkages Between Disaster Risk Reduction and Livelihoods'. Tufts University.

Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G-K., Allen, S.K., Tignor, M. and Midgley, P.M (eds.) (2011). In *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC)*. Cambridge University Press: Cambridge, UK, and New York, pp. 25-64.

Field, A. (2005). *Discovering Statistics Using SPSS*. Second edition. Sage Publications: London.

Financial and Fiscal Commission (2012). *Building an Inclusionary Housing Market: Shifting the Paradigm for Housing Delivery in South Africa*. Report on the Public Hearings on Housing Finance.

Fierlbeck, K. (1997). 'Getting Representation Right for Women in Development: Accountability, consent and the articulation of women's interests'. In Goetz, A.M. (ed.), *Getting Institutions Right for Women in Development*. Zed Books: London.

Furedi, F. (2007). 'The Changing Meaning of Disaster'. *Area*, vol. 39, pp. 482-489.

Gaillard, J.C. (2010). 'Vulnerability, Capacity and Resilience: Perspectives for climate and development policy'. *Journal of International Development*, vol. 22, pp. 218-232.

Gilbert, A. (2004). 'Helping the Poor Through Housing Subsidies: Lessons from Chile, Colombia and South Africa'. *Habitat International*, vol. 28, pp. 13-40.

Goebel, A. (2007). 'Sustainable urban development? Low-cost housing challenges in South Africa'. *Habitat International*, vol. 31, pp. 291-302.

Govender, T., Barnes, J., and Pieper, C. (2011). 'Housing Conditions, Sanitation and Associated Health Risks in Selected Low-Cost Housing Settlements in Cape Town, South Africa'. *Habitat International*, vol. 35, pp. 335-342.

Gugulethu Anti-Eviction Campaign (2011). 'The Yearly Rains Return and Re-Flood Informal Settlements and Backyards'. *Gugulethu AEC Press Statement*. Available at <http://abahlali.org/node/8083>, accessed September 2012.

Guha, D., Vos, F., Below, R., and Ponserre, S. (2012). *Annual Disaster Statistical Review 2011: The numbers and trends*. Centre for Research on the Epidemiology of Disasters (CRED). Université Catholique de Louvain: Brussels.

Gunther, I. and Harttgen, K. (2009). 'Estimating Households Vulnerability to Idiosyncratic and Covariate Shocks: A novel method applied to Madagascar'. *World Development*, vol. 37, no. 7, pp. 1222-1234.

Gupta, M. (2010). 'Filling the Governance 'Gap' in Disaster Risk Reduction'. Issue Paper on Accountability and Partnerships in DRR prepared for the UNISDR's Global Assessment Report on Disaster Risk Reduction. United Nations: Geneva.

Heijmans, A. (2001). '*Vulnerability: A matter of perception*'. University College of Befield Greig Hazard Research Centre: London.

Hewitt, K. (ed.) (1983). *Interpretations of Calamity*. Allen and Unwin: Winchester, Massachusetts.

Hewitt, K. (1997). *Regions of Risk: A geographical introduction to disasters*. Addison Wesley Longman: Essex.

Himlin, B. (2008). 'The People's Housing Process: Enhanced!' *Sangonet Pulse*, 26th November 2008. Available at www.ngopulse.org/article/people%E2%80%99s-housing-process-enhanced, accessed August 2011.

Hilhorst, D. (2004). 'Complexity and Diversity: Unlocking social domains of disaster response', in Hilhorst D. and Bankoff G. (eds.). *Mapping Vulnerability: Disasters, development and people*. Earthscan: London.

- Hilhorst D. and Bankoff G. (eds.) (2004). *Mapping Vulnerability: Disasters, development and people*. Earthscan: London.
- Horlick-Jones, T. and Sime, J. (2004). 'Living on the Border: Knowledge, risk and transdisciplinarity'. *Futures*, no. 36, pp. 441-456.
- Horlick-Jones, T. (1995). 'Modern Disasters as Outrage and Betrayal'. *International Journal of Mass Emergencies and Disasters*, vol. 13, no. 3, pp. 305-315.
- Hochrainer, S. and Mechler, R. (2011). 'Asian megacities: A case for risk pooling?' *Cities*, vol. 13, no. 328, pp. 305-31553-61.
- Hosseini, M. (2007). 'On the Effect of Urban Features on Human Casualty Level in Large and Populated Cities', *Asian Disaster Management News*, vol. 13, no. 2, pp. 9-10.
- Huchzermeyer, M. (2007). 'The New Instrument for Upgrading Informal Settlements in South Africa'. In Huchzermeyer, M. and Karam, A. (eds.) *Informal Settlements: A perpetual challenge?* Juta Academic Publishers: Cape Town.
- Huchzermeyer, M. (2003). 'Low-Income Housing and Commodified Urban Segregation in South Africa'. In Haferburg, C. and Obenbrugge, J. (eds.), *Ambiguous Restructuring of Post-Apartheid Cape Town*. Munster, Hamburg and Lit Verlag: London.
- Jha, A., Bloch, R. and Lamond, J. (2012). *Cities and Flooding: A guide to integrated urban flood risk management for the 21st century*. World Bank: Washington DC.
- Jha, A., Lamond, J., Bloch, R., Bhattacharya, N., Lopez, A., Papachristodoulou, N., Bird, A., Davies, J., and Barker, R. (2011). 'Five Feet High and Rising: Cities and flooding in the 21st century'. *World Bank Policy Research Working Paper*, no. 5648.
- Kabeer N. (1989). 'Monitoring Poverty as if Gender Mattered'. *Reversed Realities*. IT Publications: London.

Kelman, I. and Spence, R. (2003). 'A Failure Flowchart for Buildings'. *Municipal Engineer*, no. 156, issue ME3, pp. 207-214.

Kelman, I. (2002). *Physical Flood Vulnerability of Residential Properties in Coastal, Eastern England*. PhD dissertation, University of Cambridge.

Lavell, A. (2003). 'Approaches to the Construction of Risk Indicators at Different Spatial or Territorial Scales and the Major Components of Indicator Systems: Conceptual bases, risk construction, processes and practical implications'. Input paper for the *Informational and Indicators Programme for Disaster Risk Management project*.

Leary, N., Adejuwon J., Baliley W., Barros, M., Caffera, S., Chinvanno, S., Conde, C., De Comarmond, A., De Sherbinin, T., Downing H., Eakin, H., Nyong, M., Opondo, B., Payet, R., Pulhin, F., Ratnasiri, E., Sanjak E., von Maltitz, G., Wehbe, M., Yin, Y. and Ziervogel, G. (2005). *For Whom the Bell Tolls, Vulnerabilities in a Changing Climate*. Synthesis report from the Assessments and Impacts and Adaptations to Climate Change (AIACC) project, AIACC: Washington DC.

Levine, S., Pain, A., Bailey, S. and Fan, L. (2012). 'The relevance of 'resilience''?. *Humanitarian Policy Group Policy Brief*, no. 49. Overseas Development Institute: London.

Mack, N., Woodson, C., MacQueen, K., Guest, G. and Namey, E. (2005). *Qualitative Research Methods: A data collector's field guide*. Family Health International: North Carolina.

Maclear, L. (1995). 'Cape Town Needs Groundwater: A Note on the Potential of the Cape Flats Aquifer Unit to Supply Groundwater for Domestic Use in the Cape Town Metropolitan Area'. *Technical report No. Gh3868*. Geohydrology Directorate, Department of Water Affairs and Forestry, Cape Town.

Maguire, B. and Hogan, P. (2007). 'Disasters and Communities: Understanding social resilience'. *The Australian Journal of Emergency Management*, vol. 22, no. 2, pp. 16-20.

Manyena, S. (2006). 'The Concept of Resilience Revisited'. *Disasters* vol. 30, no. 4 pp. 433-450.

Mathews, E., Taylor, P., Kleingeld, M. And Geyser, M. (2002). 'Defining a New Condensation Boundary for Low-Cost Houses in South Africa'. *Building and Environment*, vol. 38, pp. 1475-1484.

Mayoux, L. (2006). 'Quantitative, Qualitative or Participatory? Which method, for what and when'. In Desai, V. and Potter, R., *Doing Development Research*. Sage Publications: London and California.

McCarthy, J., Canziani, O., Leary, N., Dokken, D. and White, K.S. (2001). *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Cambridge University Press: Cambridge and New York.

Mileti, D. and Gailus, J. (2005). 'Sustainable Development and Hazards Mitigation in the United States: Disasters by design revisited'. *Mitigation and Adaptation Strategies for Global Change*, vol. 10, issue 3, pp. 491-504.

Mileti, D. (1999). *Disasters by Design: A reassessment of natural hazards in the United States*. Joseph Henry Press: Washington DC.

Misselhorn, M. (no date). *A New Response to Informal Settlements*. Afesis-Corplan website. Available at www.afesis.org.za/Sustainable-Settlements-Articles/a-new-response-to-informal-settlements, accessed August 2011.

Misselhorn, M. (2008). 'Position Paper on Informal Settlements Upgrading'. Paper prepared for Office of the South African Presidency. University of KwaZulu-Natal: Durban.

Mitchell, T., Jones, L., Lovell, E. and Comba, E. (2013). *Disaster Risk Management in Post-2015 Development Goals*. Overseas Development Institute: London.

Mkuzo, T. (2011). *An Assessment of the Quality of Housing Delivery in the Nelson Mandela Bay Municipality: The beneficiaries' perspective (2008 -2010)*. Masters Dissertation. Nelson Mandela Metropolitan University, Port Elizabeth.

Mongwe, R. (2010). 'Race, Class and Housing in Post-Apartheid Cape Town'. *HSRC Review*, vol. 8, no. 4.

Morrissey, J. and Taylor, A. (2006) 'Fire risk in Informal Settlements: A South African case study'. *Open House International*, vol. 13, no. 2, pp. 98-105.

Morrow, B.H. (1999). 'Identifying and Mapping Community Vulnerability'. *Disasters* vol. 23, no. 1, pp. 1-18.

Mtyala, Q. (2012). 'Tokyo Fails to Placate Rioters'. *The Times*, 15 August. Available at www.timeslive.co.za/thetimes/2012/08/15/tokyo-fails-to-placate-rioters, accessed, September, 2012.

Mustafa, D. (2005). 'The production of an Urban Hazardscape in Pakistan: Modernity, vulnerability and the range of choice'. *Annals of the Association of Geographers*, vol. 95, no.3, pp. 566-586.

National Centre for Environmental Health (2010). *Facts About Mould and Dampness*. Centres for Disease Control (CDC). Available from www.cdc.gov/mold/dampness_facts.htm, accessed October 2011.

Ngxubaza, V. (2010). *An Investigation of the Low Cost Housing Process With Specific Reference to the Mbashe Local Municipality*. Master's dissertation, Cape Peninsula University of Technology, Cape Town.

- Ntema, J. (no date). *Contractor versus Self-Constructed Housing: Thabong and Mangaung as case studies*. Centre for Development Report. Human Sciences Research Council (HSRC): Pretoria.
- Oelofse, C. (2002). 'Dimensions of Urban Environmental Risk'. In *Urban Vulnerability: Perspectives from South Africa*. Peri-Peri Publications: Cape Town.
- Ogunfeditimi, O. (2008). *Assessment of Structural Quality of Houses Delivered Through the People's Housing Process in South Africa*. Thesis dissertation. University of Johannesburg, Johannesburg.
- Oliver-Smith, A. (2004). 'Theorising Vulnerability in a Globalised World', in Hilhorst D and Bankoff G (eds.). *Mapping Vulnerability: Disasters, development and people*. Earthscan: London.
- Oliver, P. (2006). 'Purposive Sampling'. In, Jupp, V. (ed.), *The Sage Dictionary of Research Methods*. Sage Publications: Thousand Oaks, CA.
- Parker, D. (1999). 'Flood'. In Ingleton, J. (ed.), *Natural Disaster Management*. Tudor Rose: Leicester.
- Pasteur, K. (2011). 'From Vulnerability to Resilience: A framework for analysis and action to build community resilience'. Practical Action Publishing: Rugby, UK.
- Pelling, M. (2003) *The Vulnerabilities of Cities: Natural disasters and social resilience*. Earthscan: London.
- Pelling, M. and Satterthwaite, D. (2007) *Investigating Urban Risk Accumulation in Six Countries in Africa*. The international Federation of the Red Cross and Red Crescent Societies/The Provention Consortium.
- Pelling, M. and Wisner, B. (2009) 'Introduction: Urbanisation, human security and disaster risk in Africa' in Pelling, M. and Wisner, B. (eds.) *Disaster Risk Reduction: Cases from urban Africa*. Earthscan: London and Sterling, VA.

Pieterse, E. (2009). 'Post-Apartheid Geographies in South Africa: Why are Urban Divides so Persistent?' Paper presented at the *Interdisciplinary Debates on Development and Cultures: Cities in development—spaces, conflicts and agency*, Leuven University, 15th December.

Pieterse, E. (2007). 'South African Local Governance: Ambitions, experiences and challenges, trilateral dialogue on the role of local government within a developmental state', *Planning Workshop with experts from Brazil, India and South Africa*, 26 February – 3 March, Bonn (Germany).

Pillay, U. (2008). 'Urban Policy in Post-Apartheid South Africa: Context, evolution and future directions'. *Urban Forum*, vol. 19, pp. 109-132.

Practical Action (no date). Earthquake Resistant Housing. *Technical Brief*. Practical Action: Rugby, UK.

Reek, J. (2000). *A Home of Your Own*. Available at www.afesis.org.za/Sustainable-Settlements-Articles/a-home-of-your-own, accessed August 2011.

Renn, O. (1998). *Risk Governance: Coping with uncertainty in a complex world*. Earthscan: London and Washington DC.

Rodrigues, E., Gie, J. and Haskins, C. (2006). *Informal dwelling count for Cape Town: 1993-2005*. Report published by the Strategic Information Branch, City of Cape Town. Available at http://web.capetown.gov.za/eDocuments/Informal_Dwelling_Count_38200681212_359.pdf, accessed November 2007.

Romanovsky, P. and Gie, J. (2006). *The Spatial Distribution of Socio-Economic Status, Services Levels and Levels of Living in the City of Cape Town 2001: To highlight suburbs in need*. Information & Knowledge Management Department. City of Cape Town: Cape Town.

Royston, L. (2002). 'Security of Urban Tenure in South Africa: Overview of policy and practice'. In Durand-Lasserve, A. and Royston, L. (eds.), *Holding Their Ground: Secure land tenure for the urban poor in developing countries*. Earthscan: London and Sterling, VA.

SAAH (2009). 'Turning Shelters into Homes', *SA Affordable Housing*, vol. 1, no. 3, pp. 40-42.

Sakijege, T., Lupala, J. and Sheuya, S. (2012). 'Flooding, Flood Risks and Coping Strategies in Urban Informal Residential Areas: The case of Keko Machungwa, Dar es Salaam, Tanzania'. *Jamba: Journal of Disaster Risk Studies*, vol. 4, no. 1.

Schneiderbauer, S. and Ehrlich, D. (2006). 'Social Levels and Hazard (In)dependence in Determining Vulnerability'. In Birkmann, J. (ed.) *Measuring Vulnerability to Natural Hazards*. United Nations University Press: Tokyo, New York and Paris.

Schoon, M.A. (2005). 'Short Historical Overview of the Concepts of Resilience, Vulnerability and Adaptation', paper present at the workshop on *Political Theory and Policy Analysis*, 29 January, Indiana University, Working paper W05-4.

Seekings, J., Jooste, T., Muvemba, S., Coqui, M., and Russell, M. (2010). *The Social Consequences of Establishing 'Mixed' Neighbourhoods*. Report for the Department of Local Government and Housing. Cape Town: Centre for Social Science Research.

Sen, A. (1981) *Poverty and Famines: An essay on entitlement and deprivation*. Clarendon Press: Oxford.

Slum Dwellers International (SDI) South African Alliance (no date). *About Utshani*. Available at www.sasdialliance.org.za/, accessed July 2011.

Smith, W. (2008). 'Isidima: Creating dignified communities', in *The State of the Province Report 2008*. Office of the Premiere: Cape Town.

Smith, K. (2001). 'Hazard in the Environment'. In *Environmental Hazards: Assessing risk and reducing disaster* (third edition). Routledge: London and New York.

Smith, K. and Petley, D. (2009). *Environmental Hazards: Assessing Risk and Reducing Disaster* (fifth edition). Routledge: London and New York.

Sogunro, O. (2002). 'Selecting a Quantitative or Qualitative Methodology: An experience'. *Education Research Quarterly*, vol. 26, no. 1.

South African Cities Network (2006). *State of the Cities Report 2006*. South African Cities Network: Braamfontein. Available at www.sacities.net/left/documents.stm, accessed November 2007.

Susman, P., O'Keefe, P. and Wisner, B. (1983). 'Global disasters, a radical interpretation'. In *Interpretations of Calamity*. Allen and Unwin Inc.: London and Sydney.

Swift, J. (1989) 'Why Are Rural People Vulnerable to Famine?', *IDS Bulletin* vol. 20, no. 2, pp. 8-15.

Swift, J. (1993) 'Understanding and Preventing Famine and Famine Mortality', *IDS Bulletin*, vol. 24, no. 4, pp. 1-15.

Thywissen, K. (2006). 'Core Terminology of Disaster Reduction: A comparative glossary'. In Birkmann, J. (ed.) *Measuring Vulnerability to Natural Hazards*. United Nations University Press: Tokyo, New York and Paris.

Tipple, G. (2005). 'Housing and Urban Vulnerability in Rapidly-Developing Cities'. *Journal of Contingencies and Crisis Management*, vol. 13, no.2.

Tissington, K. (2010). *A Review of Housing Policy and Development Since 1994*. Paper prepared for the Studies in Poverty and Inequality Institute (SERI). Available at www.spii.org.za/agentfiles/434/file/Research/Review%20of%20the%20Right%20to%20Housing.pdf, accessed August 2011.

Tomlinson, M. (2011). 'Managing the Risk in Housing Delivery: Local government in South Africa'. *Habitat International* vol. 35 p. 419-425.

Tonkin, A. (2008). 'Samora Machel'. In Tonkin, A. (ed.). *Sustainable Medium-Density Housing: A resource book*. Development Action Group: Cape Town.

Twigg, J. (1998). 'Understanding Vulnerability: An introduction'. In Twigg, J. and Bhatt, M. (eds.) *Understanding Vulnerability: South Asian perspectives*. Duryog Nivaran and Intermediate Technology Publications Ltd: Colombo and London.

Turok, I. (2011). 'Deconstructing Density: Strategic dilemmas confronting the post-apartheid city'. *Cities*, vol. 28, pp. 470–477.

Turok, I. (2001). 'Persistent Polarisation Post-Apartheid? Progress towards urban integration in Cape Town'. *Urban Studies*, vol. 38, no. 13, pp. 2349-2377.

United Nations Development Programme (2004). *Reducing Disaster Risk: A challenge for development*. United Nations: New York.

UNISDR (2004) *Living with risk: A global review of disaster reduction initiatives*. United Nations: Geneva.

UNISDR (2009a). *Global Assessment Report on Disaster Risk Reduction: Risk and poverty in a changing climate*. United Nations: Geneva.

UNISDR (2009b). *2009 Terminology on Disaster Risk Reduction*. United Nations: Geneva.

UNISDR (2011). *Global Assessment Report 2011*. United Nations: Geneva.

United Nations International Strategy for Disaster Reduction (UNISDR) (2013). *Global Assessment Report 2013*. United Nations: Geneva.

Von Kotze, A. (1999). 'A New Concept of Risk'. In *Risk, Sustainable Development and Disasters: Southern perspectives*. Peri-Peri publications: Cape Town.

Viljoen, M. and Booysen, H. (2006). 'Planning and Management of Flood Damage Control: The South African Experience'. *Irrigation and Drainage*, no. 55, pp. S83–S91.

Wentzel, L. (2010). *An Analysis of Quality Assurance in Low-Cost Housing Construction*. Masters dissertation. Cape Peninsula University of Technology, Cape Town.

Watts, M. (1983). 'On the Poverty of Theory: Natural hazards research in context'. In Kenneth Hewitt (ed.), *Interpretations of Calamity*. Allen and Unwin: Winchester, Massachusetts.

Wessels, W. (1981). 'Hydrology of the Western Cape Lowlands with Special Reference to the Cape Flats'. In Moll, E. (ed.), *Proceedings of a Symposium on Coastal Lowlands of the Western Cape*, March 19-20, University of the Western Cape.

Wisner, B. and Pelling, M. (2009) 'African Cities of Hope and Risk'. In Pelling, M. and Wisner, B. (eds.), *Disaster Risk Reduction: Cases from urban Africa*. Earthscan: London and Sterling, VA.

Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004) *At Risk: Natural hazards, people's vulnerability and disasters*, second edition. Routledge: London and New York.

Wisner, B. (2001). 'Vulnerability' in *Disaster Theory and Practice: From soup to taxonomy, then to analysis and finally tool*'. Presentation at the *International Work-Conference* hosted by the Disaster Studies unit of Wageningen University and Research Centre, 29-20 June, Wageningen, the Netherlands.

Wilkinson, P. (2000). 'City Profile: Cape Town'. *Cities*, vol. 17, no. 3, pp. 195-205.

World Bank (2011). *Climate Change, Disaster Risk and the Urban Poor: Cities building resilience for a changing world*. World Bank: Washington DC.

Zevernbergen, C., Veerbeek, B., Gersonius, B., and van Herk, S. (2008). 'Challenges in Urban Flood Management: Travelling across spatial and temporal scales', *Journal of Flood Risk Management*, pp. 81-88.

Zevenbergen, C. (2007). *Adapting to Climate Change: Towards flood resilient cities*. Inaugural address, UNESCO-Institute for Water Education: Delft.

Ziblim, A. (2013). 'The Dynamics of Informal Settlements Upgrading in South Africa: Legislative and policy context, problems, tensions, and contradictions'. Report prepared for Habitat for Humanity International, EMEA Office: Slovakia.

Ziervogel, G. and Smit, W. (2009). 'Learning to Swim: Strengthening flooding governance in the city of cape town'. Paper presented at *the 2009 Amsterdam Conference on the Human Dimensions of Global Environmental Change*, Amsterdam, 2-4 December.

Zweig, P. (2006). *The Cape Town Community Housing Company: The registration of land process in their first eight housing developments and implications for the transfer of ownership to beneficiaries*. Research report, Department of Environmental and Geographical Science, University of Cape Town.

Government documents and policies

CitySpace (2012). *Cape Town Spatial Development Framework: Statutory Report*. City of Cape Town: Cape Town.

City of Cape Town (2006). *State of Cape Town Report 2006: Development issues in Cape Town*. City of Cape Town: Cape Town.

City of Cape Town (2009). *Five-Year Integrated Housing Plan 2009/10 – 2013/14*. Housing Directorate, City of Cape Town: Cape Town.

City of Cape Town (no date). *Informal Settlements in the City of Cape Town*. City of Cape Town: Cape Town.

Department of Housing (2004). *Breaking New Ground: A comprehensive plan for the development of sustainable human settlements*. Department of Housing: Pretoria (Tshwane).

Government of South Africa (2010). *SA Yearbook 2009/10: Human settlements*. Government of South Africa: Tshwane.

Housing Development Agency (2011). *N2 Gateway*. HDA website. Available at www.thehda.co.za/how_we_work/projects_and_programmes_function/n2_gateway/, accessed July 2011.

Human Settlements Department (2009). *The National Housing Code*. Human Settlements: Pretoria (Tshwane).

South African Bureau of Standards (1990). *South African National Standard: The application of the National Building Regulations*. SABS Standards Division: Pretoria.

APPENDIX 1

Key informants consulted during the qualitative phase

City of Cape Town:

- Abduragmaan Hendricks, Disaster Risk Management Centre, City of Cape Town
- Barry Wood, Roads, Stormwater and Catchment Management Directorate, City of Cape Town
- Bernard Vencil, Town Planning Department, City of Cape Town
- Enoch Kopele, Disaster Risk Management Centre, City of Cape Town
- Fran Curry, Town Planning Department (Philippi), City of Cape Town
- Lennox Mashazi, Disaster Risk Management Centre, City of Cape Town
- Mogamat Kenny, Roads, Stormwater and Catchment Management Directorate, City of Cape Town

Ward councillors:

- Monwabisi Mbaliswana, Councillor, Ward 33
- Moses Biskiti, Councillor, Ward 80
- Mzwandile Matiwane, Councillor, Ward 80
- Nomhlobo Klaas, Councillor, Ward 40
- Thobile Gqola, Councillor, Ward 35
- Sheham Simms, Councillor, Ward 40

Other actors:

- Andre Wust, Project Manager (ret.), Development Action Group (DAG)
- Andrea Bolnick, Community Organisation Resource Centre (CORC)
- Gerry Adlard, Integrated Serviced Land Project (iSLP), Caleb Consulting
- Julian Conrad, Geohydrological and Spatial Solutions International (GEOSS).

- Merle Sowman, Department of Environmental and Geographical Science, University of Cape Town
- Professor Richard Fuggle, Department of Environmental and Geographical Science, University of Cape Town
- Patricia Zweig, Disaster Management for Sustainable Livelihoods Programme, University of Cape Town
- Shawn Cuff, Architect, associated with the Federation for the Urban Poor (FEDUP)
- Stephen Devereux, Institute of Development Studies, University of Sussex

University of Cape Town

APPENDIX 2

Focus Group Discussion Guide

General questions:

- What, if any, kinds of problems do people experience in this area when it rains?
- About what proportion of people experience flooding in this area?
- What kinds of flooding do people experience in this area? (probe: run-off from roads, leaking roofs, high water table etc.)
- Does everyone experience these types of flooding, or are people in different parts of the settlement affected by different kinds of flooding?
- Do people experience different kinds of flooding at the same time?
- Which type of flooding occurs most often?
- Which type of flooding has the biggest negative impact?
- How does this kind of flooding impact on people? Why is this bad?
- Is it easy for people to recover from bad cases of flooding? Why?

Flooding-specific questions (*linked to an aerial photo or group-drawn map of the community; questions for main type(s) of flooding*)

- Where do the people most affected by [___] type of flooding live?
- What is it about the location or construction of these dwellings that makes them prone to this type of flooding?
- What are the typical characteristics (social, material etc.) of the households in this part of the settlement (probe, picking households from the photo/map)?
- What are the typical characteristics (social, material etc.) of the worst affected households (probe, picking households from the photo/map)?
- What is it about the location or construction of the dwellings in other parts of the settlement that prevents them from experiencing this type of flooding?
- Are there things that people specifically do to reduce the likelihood of experiencing this kind of flooding? How successful are these?

APPENDIX 3

Summary of the survey questionnaire

Elevation
Visual survey <ul style="list-style-type: none">• Type of dwelling• Building type• Main material used for the walls• Main material used for the roof• Roof flat, sloped or A-shaped• Roof overhangs exterior walls of the house and by how much• Dwelling has a ceiling• House has guttering and whether guttering leads into purpose-build drain• Formal drainage on plot to drain water away from dwelling• Size of the space between dwelling and house next door• Main material used for the floor• Height of floor relative to street or ground level• Proximity to roads, canals or drainage ditches and drains
Characteristics of the household <ul style="list-style-type: none">• Length of time in settlement• Length of time in house• Dwelling ownership• Bond or loan commitment• Where household head lived prior to moving to settlement• Respondent's relationship to household head• Gender of household head• Age of household head
Income and expenditure <ul style="list-style-type: none">• Number of people living permanently in household• Number of children under 18• Number 60 or older• Number employed full-time• Number employed part-time, seasonally or every now and then• Number self-employed• Number receiving a pension, child-care, foster or disability grant• Average amount spent on necessities like food each month• Average amount sent as remittances elsewhere each month• Average amount spent on bills like rent, school fees, water and electricity each month• Average amount spent on transport each month• Average amount spent on medical bills or expenses each month• Average amount put towards savings each month• Average amount insurance each month\• Average income coming into households after tax each month <p>For formal dwellings:</p> <ul style="list-style-type: none">• Whether household has expenses they did not have before moving into formal house

- Nature of expenses
- Amount

Experience of flooding

- Prioritisation of storm-water control measures relative to other costs
- Biggest environmental or social problem in settlement
- Water-related problems experienced in settlement

	If experience when in rains	Average times each year	On how many separate occasions during last three winters	On how many separate occasions in 2010	Which has the greatest financial impact (if any)	Which has the greatest financial impact (if any)
Water running into dwelling from roads, streets or slopes	*	*	*	*	*	*
Water running into dwelling from overflowing canals or drainage ditches	*	*	*	*	*	*
Water running into dwelling from water pooling in yard	*	*	*	*	*	*
Water or damp coming up through the floor	*	*	*	*	*	*
Leaking roof	*	*	*	*	*	*
Leaking walls	*	*	*	*	*	*
Leaking around doors and window frames	*	*	*	*	*	*
Other (Specify)	*	*	*	*	*	*

Impact

- Way in which nominated flooding impacts on quality of life
- Way in which nominated flooding impacts financially
- Needed to spend money as a direct result of the most serious even in last three years
- Amount spent
- Where money obtained from
- Received assistance from government
- Received assistance from family, friends, family or others
- Nature of assistance
- Support networks

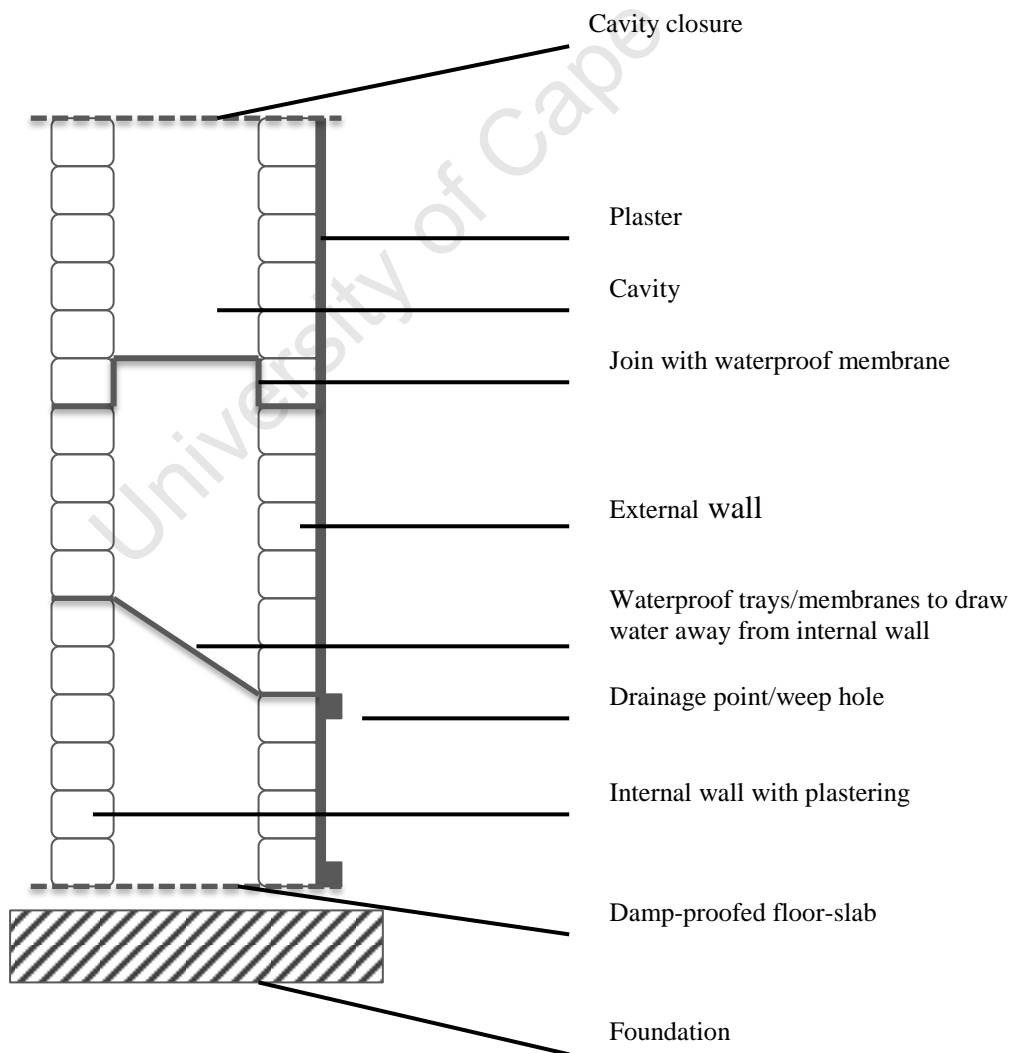
Mitigation measures

	Informal dwellings	Formal dwellings
Take measures to reduce likelihood of house being flooded	*	*
Measures undertaken	*	*
Effectiveness	*	*
Amount spent over the last 12 months	*	*
Have insurance for household contents or house	*	*
Ever considered getting insurance	*	*
House built by developer, construction company or PHP		*
When house built		*
Time taken		*
Say in who built house		*
Say in how house designed		*
Able to monitor how houses built/quality		*
House has cavity walls		*
House has ventilation panels		*
All windows open		*

APPENDIX 4

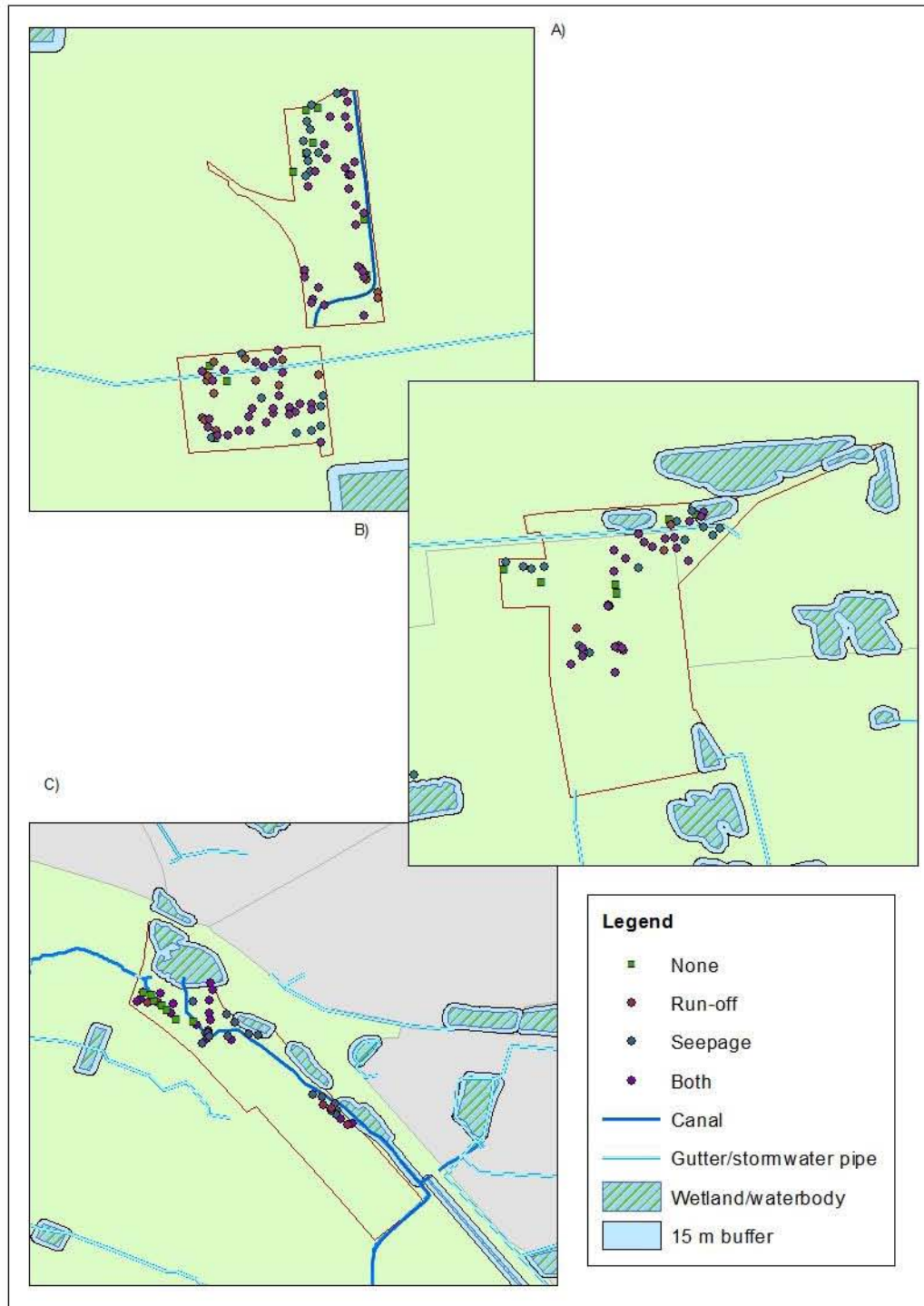
Diagramme of a cavity wall

A cavity wall comprises a double-skinned wall with a gap (cavity) in the middle designed to prevent water rising into the wall from the ground or from penetrating from the exterior wall. All brickwork and concrete is porous and without waterproofing will allow water to penetrate. The cavity prevents this from happening. The walls contain drainage points to drain away any water than penetrates the external wall, as well as waterproof materials prevent water from crossing anywhere the two skins meet.



APPENDIX 5

Experience of run-off and seepage by proximity to waterbodies in informal settlement areas



APPENDIX 6

Illustrations of the physical differences between housing models

Figure 41: Examples of PHP housing

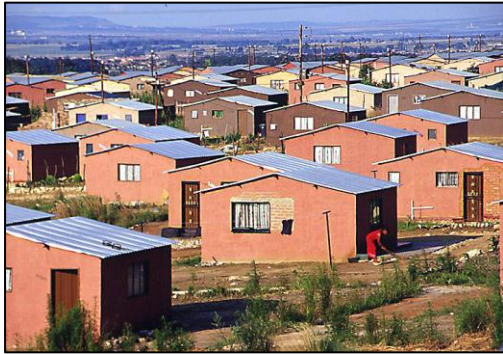


Figure 42: Example of a 'RDP' settlement



a) Westonaria Borwa, Gauteng



b) N2 Gateway, Cape Town

Figure 43: Examples of housing built under the BNG



a) Verena, Mpumulanga



b) Diepsloot, Gauteng