FLOOD RISKS AND THEIR IMPACT ON INSURANCE COMPANIES: THE CASE OF GEORGE LOCAL MUNICIPALITY, AT THE SOUTH COAST OF SOUTH AFRICA

By

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Submitted in partial fulfilment of the requirements for the degree
Masters in Disaster Management

In the

Disaster Management Training and Education Centre for Africa

At the

UNIVERSITY OF THE FREE STATE

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2011

DECLARATION

I declare that this research is entirely my own, unaided work, except where otherwise stated. All sources referred to are adequately acknowledged in the text and listed.
I accept the rules of assessment of the University of the Free State and
the consequences of transgressing them.

This treatise is being submitted in partial fulfilment of the requirements for the master's degree in Disaster Management at the University of the Free State. It has not been submitted before for any degree or examination at any other university.

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Signature of Student

RECOGNITION AND ACKNOWLEDGEMENTS

Any endeavour, such as this thesis, inevitably involves the assistance and support of a number of people and institutions. I would like to thank them all. However, a few people were especially instrumental in helping me to complete this study and they deserve special mentioning. I would like to extend my gratitude to:

Mrs M. Storie, my supervisor, for her invaluable support, encouragement, motivation, input, constructive criticism, patience and competent academic guidance throughout the duration of this research.

Mr C. Swiegers, & Prof M. F. Viljoen my mentors, who supported the whole concept of this research.

The employees of George Local Municipality who participated and cooperated in the research (Mr H. Basson, Mrs L. Mooiman, Mr M. Swart and others.

Mrs M. Botha, of The George Herald newspaper, for the provision of flood damage images.

Mrs A. Van Dyk & Mr J. Van Der Merwe for their support in information and technological guidance, I am truly thankful.

The South African Weather Services team, for provision of rainfall data (Mr M. Gwata & Mrs M. Gill).

The South African Insurance Association for their invaluable assistance with flood claim reports.

Finally, to God almighty for giving me the strength, guidance, wisdom and power to complete my research study.

DISSERTATION DEDICATION

This dissertation is dedicated to my brother, Kabelo, and my mother, Manxwalo, for their continuous support, guidance and love. Without their seemingly endless patience and encouragement, this work would not have been completed. I have accomplished a personal dream through this mini-dissertation. The family support I received made this possible. It proved that anything is possible through hard work and dedication.

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ABSTRACT

Flood risk poses major problems for the community and insurance companies alike. Annually, losses resulting from floods have a direct or indirect impact on insurance levies and payouts. This study aims to investigate the extent of flood impact on insurance in the George Local Municipality (GLM). A quantitative methodology was utilised, to analyse four data sets, in an attempt to determine the flood impact in the GLM. These included: a) questionnaire completed by specialists; b) observations through a transect walk through a selected portion of the study area; c) data from the South Africa Insurance Association claims and payout database; and d) the data from South African Weather Services regarding weather and storm occurrences. The findings indicate that floods is a major natural hazard that set back development in the area; spring and winter seasons are the peaks months of rainfall occurrences (1921 to 2007); the 2006/07 rainfall year reflected unusually high claims related to flood damage in the GLM. The study furthermore indicates that floods have divesting impact on insurance, the insurance industry has lost an estimated total of R 3, 869,000 (which amounts approximately UK £ 3.22 million pounds) on the 2006/7 floods alone. As a response to the 2006/7 floods, internationally acceptable mitigation and prevention measures have been identified to reduce the flood impact in the GLM. Finally, recommendations are presented for future research in relation to flood risks and the insurance industry, where this study was not able to provide details.

ABBREVIATIONS

BCPR:	Bureau for Crisis Prevention and Recovery
COGTA:	Department of Cooperative Governance and Traditional Affairs
OCHA:	Coordination of Humanitarian Affairs for Southern Africa
DWA:	Department of Water Affairs
DiMP:	Disaster Mitigation for Sustainable Livelihoods Programmes
FASTER:	Flood and Storm Event Reporting System
FEMA:	Federal Emergency Management Agency
FIRMs:	Flood Insurance Rate Maps
GLM:	George Local Municipality
GIS:	Geographical Information Systems
IDP:	Integrated Development Plan
JOC:	Joint Operation Centre
m:	Mitres
mm:	Millimetres
Ml/day:	Millilitres per day
mm^3:	Cubic Millimetres
NFIP:	National Flood Insurance Programme
NDMC:	National Disaster Risk Management Centre
NWRS:	National Water Resource Strategy
pH:	Potential Hydrogen
ROSA:	Rig of Safety Assessment

SA:	South Africa
SAIA:	South African Insurance Association
SAWS:	South African Weather Services
SQL:	Structured Query Language
EU:	European Union
UK:	United Kingdom
USA:	United States of America
WFD:	Water Framework Directive
WWTW:	Wastewater Treatment Works

DEFINITION OF TERMS

Claim - A demand to recover for a loss covered by insurance (Clark, 1998).

Coverage - According to (*ibid*), it is a synonym for insurance indicating how much protection the insurance provides.

Flood insurance - Defined as an insurance that protects home owners and companies from the cost of damages to a property because of flooding or high water. To determine risk factors, insurance companies will traditionally, often refer to topographical maps that denote lowlands and flood plains that are susceptible to flooding (Penning-Rowsell, Johnson, Tunstall, Tapsell, Morris, Chatterton & Green, 2005).

Floodplain - Defined as the area susceptible to inundation by a recurring flood, as determined by specialists or local authorities as indicated diagrammatically in Annexure B (FEMA, 2007). This could be defined as a 1:20, 1:50, 1:100 or 1:200 year flood within any given river reach, which translates to a probable return period. It is based on a variety of inputs, including previous recorded flood levels, rainfall counts, infiltration rates of various types of surfaces, and topography.

Floodplain management - The process of an overall programme of corrective and preventive measures for reducing flood damages to the environment and the economy,

Ibid is short for the Latin *ibidem.* The word refers to "an expression used in bibliographies when authors repeatedly cite the same source" (Belanger, 2003).

including but not limited to, development and planning guidelines, emergency preparedness plans, flood control measures, and floodplain management policies (*ibid*).

Flood risk - A combination of the probability and consequences of flooding. To estimate flood risk requires a system model that may be conceptual or quantified, which includes sources, pathways and receptors (Penning-Rowsell *et al*, 2005).

Homeowner's Policy - According to Clark (1998), it is a package of insurance coverage providing homeowners with a broad range of personal property, dwelling, and liability protection.

Re-insurance - A system that reduces risk for insurance companies. In effect, it is a method whereby an insurer buys, rather than sells, insurance. It makes insurance safer for both the insurer and the policy holder (Athearn, Pritchett & Schmit, 1989).

CHAPTER ONE

1. INTRODUCTION

1.1. BACKGROUND

1.1.1 Flood risk impacts

Flood risks pose one of the greatest and most widely distributed disaster risks that result from natural hazards, to physical structures throughout the world (Parklina, 2003). These disasters account for damage and destruction of approximately a third of that originating from all natural hazards in terms of mortality and economic losses, and are for example responsible for more than half of all fatalities brought about by natural events in the United Kingdom (Kok & Barendregt, 2004). According to Hung and Hwang (2003), flood trend analyses revealed that major flood disasters and the losses generated by them have increased significantly in recent decades and are expected to continue to grow in frequency and severity in the future.

1.1.2 Risk Identification

Identifying flood risks require a systematic analysis of all the potential impacts of the flood on natural and man-made environments, as well as social cohesion in affected communities. In this context, risk identification must consider all flood impacts, whether it be positive or negative (Mileti, 1999). This means that risk analyses should consider the origins of the flood risks as well as the individuals or population at risk, their resilience and vulnerability or the vulnerability of the land they live on, the type of insurance companies involved in insuring against flood risk, as well as defining the conditions of exposure to floods and provision of cover related to flood damages. The main aim of risk identification in this sense is therefore to examine carefully all possibilities of harm or damages and its likelihood of occurrence (Environmental Risk Management Authority, 1999).

1.1.3 Flood insurance importance

Traditional principles of insurance risk management are mainly based on the probability of statistically measurable historical and predictable distribution of future events geographically and over time, which allows insurance companies to finance losses of random occurrences of relatively modest magnitudes through contributions of their policy holders (Pollner, 2001). Flood insurance should ideally encourage reduction of uncertainty caused when individual policy owners become aware of their inability to predict unique and individual future potential dangers and outcomes**.** Home owners may reduce their exposure to the uncertainty of events, by spreading the economic burden of loss among members of an insured group. Flood insurance, as all other insurances, therefore does not *prevent* loss, but *relieves* individuals, or community, organisation or municipality of the financial burden *in the event of a loss occurring* (Anderson, 2002).

1.1.4 Reasons for building in floodplains

According to Crichton (2002), there are often economic reasons for allowing building or development in floodplains. Such instances include the development of harbours, where rapid densification of settlements take place, where parking is required, where recreation areas, golf course or parks are required, where there is a perceived higher value of properties on riverfronts and along estuaries, and where industries are developed near water courses for purposes of e.g. utilisation for cooling properties (e.g. sanitation/sewer works or mining operations). Even though it may be desirable, the long-term maintenance and insurance cost of such land uses or developments needs to be considered while taking into account the potential risk for human safety, and damage or destruction of infrastructure. If infrastructure and buildings are to be insurable in the future, then the uncertain predictions surrounding global climate change will increase the uncertainty regarding flood risk. This requires such structures and land use areas to be at least adequately designed, considering its purpose for use, the materials used in construction and surfacing, and defended through e.g. re-enforced wall structures. Solutions such as architectural design, site layout, permeability of surfaces and on-site attenuation may provide some relief without necessarily incurring additional costs; however structural solutions such as concrete or earth embankments are expensive to design, construct and maintain (Collin, Thorne & Penning-Rowsell, 2007). When floods occur in communities, lives may be lost, infrastructure (and especially critical infrastructure) may be damaged, drainage systems destroyed, farmers may lose their livestock, and agricultural production may be negatively affected. Insurance companies in turn receive claims for many of these damages and losses, which, if their risk assessments are not based on accurate probabilities, may cause them to suffer huge financial losses (Grace & Klein, 1999). The research aims to provide insight on the insurance industry, because they may play a positive role in reducing and managing flood risks by encouraging adaptation and mitigation measures to the policy holders, and urging avoidance of development in high risk areas.

1.1.5 Flood mitigation and prevention

According to Burby & Dalton (1994), there are many ways to help prevent and mitigate floods, such as: construction of drainage ditch and gabions alongside rivers to keep them from overflowing during periods of high water levels; canals can also be used to help channel the additional water that need to be managed during and after storm surges (Anderson, 2002); streams and rivers can be diverted to avoid highly populated areas or may be re-engineered to contain flood waters more effectively, while regulation of development in flood plains and urbanisation which influence infiltration and runoff may reduce exposure, and thereby curb flood losses. Other potential measures to mitigate the impact of floods include the prevention of soil erosion (which clogs up attenuation structures downstream and diminish their capacity to reduce the potential for flooding) through vegetation cover, tree root systems and other appropriate measures further helps to control flooding; and management of slopes and increasing slope stability with semi-ecological interventions (gabions, etc) and reservoirs which can be created to catch sediments, waste and other debris, thereby potentially avoiding blockage of the stormwater systems (McCann, Janice & Shand, 1995). According to Maynard (2008), the layout, architecture and construction methods of property can contribute significantly to reducing weather-related risks, while bad planning and inappropriate construction techniques can increase these risks significantly (Penning-Rowsell, Green, Thompson, Coker, Tunstall, Richards, & Parker, 1992).

Table 1: Selected forms of flood damages

<table>
<tr><th colspan="4">MEASUREMENT</th></tr>
<tr><th colspan="3">TANGIBLE DAMAGES</th><th>INTANGIBLE DAMAGES</th></tr>
<tr><td rowspan="2">Form of damage</td><td>Direct</td><td>Physical damage to assets e.g.:

Buildings

Contents

Infrastructure</td><td>Loss of life

Negative health effects

Loss of ecological assets and services</td></tr>
<tr><td>Indirect</td><td>Loss of industrial production and associated income and tax base

Traffic disruption

Disruption of supply of goods, services and food

Emergency response and disaster management costs</td><td>Inconvenience (and sometimes impossibility) of post-flood recovery

Increased social disruption and vulnerability of survivors

Psychological impact on affected communities</td></tr>
</table>

Source: Adapted from Penning-Rowsell *et al*., 2003.

A specific issue that researchers and practitioners are face with during flood loss analysis is the limitation of existing methods and available data; including for example loss functions and detailed small-scale spatial and statistical information on the elements at risk. Table 1 indicates the tangible and intangible resources that can be damaged by floods. The social, economical, environmental and physical infrastructure impacts are generally aligned with the probability of the risk. Apart from the details listed above, floods have a significant impact on insurance companies, as substantial portions of their profits earned in previous years may be swallowed up by payments that need to be made to cover the insured damages for recent floods (Huber, 2004). Without adequate trend analysis and risk management, insurance companies are unable to remain viable in the face of large-scale payouts such as occur after major flood events.

According to the George Local Municipality's Annual Report of 2006/7, The GLM spends R 229,611,998.00(which amounts approximately UK £19.2 million pounds) mainly on infrastructure maintenance, than infrastructural development. This shows that the GLM focus most of its budget on *recovery* than *prevention* and *preparedness*.

1.1.6 International flood risk

1.1.6.1 Determining damages

Floods affect the global insurance industry in that these companies have to anticipate potential large pay-outs, in the face of uncertainty surrounding the effects of climate change, the characteristics of different dwelling locations (e.g. increase cost of reconstruction on floodplains), structures and materials used to build properties in different income areas and by different people etc. Floods are often seen as having negative impacts on the, social, economical, environmental and physical infrastructure (Scawhorn & Kobayashi, 2008). Although floods may also have a positive effect, this research will focus only on the negative impacts of floods.

Examples of international flood damages are in Asia, 70 percent of all natural hazards are floods, with losses estimated at £200 million in 2002 (National Fire Agency, 2007).

Furthermore, studies that were conducted in Europe found that 80 percent of all disasters were caused by floods, which shows a higher prevalence, although infrastructural losses of only UK £15 billion in 2002 were recorded (Sanders, Shaw, MacKay, Galy & Foote, 2005). These figures not only show different levels of preparedness and mitigation that may exist in the different areas on the globe, but also highlight major concerns as these floods have both negative and positive consequences for all economic and social sectors of affected countries and districts.

1.1.7 South African flood risk

According to South Africa's National Water Resource Strategy (2002), floods occur as a natural occurrence, as a result of South Africa's highly variable rainfall. In addition, floods may also be caused by dam failures and lack of adequately designed and maintained storm water drainage infrastructure. One of the major reasons behind flooding in urban areas is increased urbanisation and flooding due to blocked stormwater infrastructure due to poor waste management by both communities and municipal service providers, which sometimes cause more floods than the originally anticipated river floods in a particular area. This management (or lack of management) thus increases the risks that flood hazards pose to municipalities, communities and insurance companies.

According to the Department of Cooperative Governance and Traditional Affairs (COGTA, 2011), nationwide floods in 2010-2011 have caused damage estimated at R356 million (which amounts approximately UK £29.7 million pounds) throughout South

Africa, with a total of 91 people killed and 8, 400 people displaced. These recent floods once again proved that floods cause loss of life and destruction of dwellings in communities who live on floodplains, as noted in earlier research (Dlugolecki, 2004; Environmental Agency, 2004; ABI, 2005).

Despite the fact that various acts and policing to mitigate flood impact are drafted, flood impact still continues to devastate communities and the insurance companies (Hulse, 1997). The South African Insurance Association (SAIA) currently does not have specific guidelines for how it covers the cost of flood damage, especially non-infrastructure damages. According to Hamilton and Malecki (1994:20), flood insurance policies should cover direct losses by floods, where floods are defined as "a general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters; the unusual and rapid accumulation or runoff of surface waters from any source; or mudslides which are proximately caused or precipitated by accumulation of waters on or under the ground". On the other hand Amrhein, Husset and Quary (1996:135), note that the "collapse or subsidence of land along the shore of a lake or other body of water, caused by erosion or undermining by waves or currents of water exceeding the normal levels, resulting in flooding" should also be covered. According to these definitions, insurance companies hold reserves to "meet the expected value of future claims and additional capital is held against unexpected events" (Few, Ahern & Mathews, 2004:63). Unfortunately, these definitions do not account for secondary and tertiary losses (e.g. flood cuts electricity supply, damaging susceptible machines and computer runs physical and psychological trauma, increased costs of emergency services, disruption of flow of employees to work, food and other shortages, loss of income etc), increased individual and household stress (which cannot be insured against), community cohesion (before and after floods) and subsequent social disruption (Hopkins, 2000), some of which have been noted in Table 1 earlier as well.

1.1.8 Flood insurance in the contexts of government agendas

According to Hutchin (2002), insurance plays a pivotal role in restoration of property and infrastructure after flood damage. This is done through claims that the affected individuals, organisations or companies make to their insurance company with regards to damaged or destroyed property. As a result of climate change and the related weather-induced risks which is a worldwide concern, the current insurance regimes for natural hazards such as floods are being critically reviewed. According to Freeman & Kunreuther (2002), Huber (2003) and Anderson (2002) the division of responsibilities between government (in the case of South Africa: national, provincial and local spheres of government) and the insurance industry has emerged as a major concern. This means in South African there is currently challenges when it comes to floods damages, normally the budget assigned to national government while it's supposed to be allocated to the local government.

In the past, it was expected that private insurance regimes (individuals insuring their homes and companies insuring their property) should be able to handle the flood recovery process more efficiently and fairly than government-based administrative systems (Alexander, 1993). Currently, the situation has not changed much, where government primarily assist people who do not have access to insurance (e.g. communities living in subsidised housing and informal settlements), while insurance companies (including national agencies such as the National Home Builders Registration Council (NHBRC) are expected compensate insurance policy holders. This is due to private insurance companies are based on conceptual assumptions rather than empirical evidence from government. According to Grace, Klein and Kleindorfer (2000), private insurance in most countries is an “additional”, scarcely used option to cover against damages, which are available to the middle and higher income classes. This leaves most low income households with limited and often inadequate government intervention after flood occurrence.

1.1.9 Re-insurance

According to Gordis (2000), insurance companies understand the importance of spreading their risks well, and therefore have avoided accepting a heavy concentration of liability in one area. Watson and Lilly (1997) claimed that insurance industries protect themselves further against catastrophic losses by re-insuring.

In addition, Lucas, Mclean and Green (1996) stated that the insurance market is an increasingly competitive market with the consequent potential for volatility. Insurers compete for the market position in an environment where competition restrains premium growth and for many insurers the means for profit growth is achieved expense reduction and integration of products (Alexandra, 2000). Re-insurance can increase capacity, stabilise profits, assist growing insurers through profitable cash flow, provide protection from catastrophic losses, as well as regulate premiums. In addition, 40 percent of the total worldwide property and casualty reinsurance premiums are written by the re-insurance companies. Re-insurance can be a profitable source of business that spreads risk and diversifies an insurer's portfolio (SwissRe, 1998).

1.2 RESEARCH QUESTION

Against the background to the study, as outlined afore, the research question is:

To what extent does the flood risk affect the insurance companies at the George Local Municipality?

1.2.1 Sub-questions

- What are the local and international policies/legal frameworks that govern flood risk insurance?
- What are the local and international constraints that flood risk have on Insurance companies?
- Do rainfall peaks have any link to the insurance between date to date claims in the George Local Municipality?
- Which sectors in the George Local Municipality are mostly affected by floods?
- What policies can be recommended to improve the relationship between insurance industries and floodplain management authorities?

1.3 OBJECTIVES OF THE STUDY

First list the main aim of the study. Research usually has one main aim, with multiple objectives

The study has the following objectives:

- To undertake a literature review in order to give an overview of the local and international policies or legal frameworks that govern flood risk insurance.
- To investigate the local and international constraints flood risk impact on insurance.
- To investigate the relationship between rainfall peaks and day to day insurance claims at the George Local Municipality.
- To identify various sectors which are affected by floods in the George Local Municipality
- To make global recommendations in improvement of the relationship between floodplain management authorities and insurance industries.

1.4 BRIEF DESCRIPTION OF THE STUDY AREA

The George Local Municipality (GLM) is located approximately 450 km east of Cape Town and 330 km south-west from Port Elizabeth, on the South African course (George Local Municipal Economic Analysis, 2005). The area covers over 1,068 square kilometres and lies between 22, 48001 longitude East and 33, 9657 latitude South, as shown in the map in Annexure A. The GLM has a total population size of approximately

160,000 people. There are 17,516 households. The study focused on the properties that filled insurance claims, and hoped for the insurance companies to pay-out. The area is generally faced with a high unemployment rate, crime, floods, overcrowding, and HIV/AIDS (Census, 2001). The study highlighted the social, economic, environmental and physical profile of the study area, to give a fair description of the GLM. A full description of the GLM is presented in Chapter 3.

In South Africa there are two “tiers” of local government: district municipalities and local municipalities. Traditionally, a district municipality has very limited functions, for instance, allocation of capital grants (derived from their levy revenue) to local municipalities, and management of a few district-level “bulk” functions (e.g. large-scale water supply). On the other hand, local municipalities are primarily responsible for local service delivery matters, including provision of electricity, houses, sanitation etc. The Eden District Municipality consist of eight local municipalities, one of which is the GLM. The GLM form part of the Eden District Municipality and the municipality has challenges with flood risks. In the 2010/2011 floods the Eden District Municipality received 250 mm of rainfall within 24 hours on 26 December 2010 to mid-January 2011. Flood damage was estimated at R32 million (which amounts approximately UK £2.7 million pounds) and most of the flood damages were recorded in the GLM. It will only be possible for the GLM residents claim approximately R500 000 (which amounts approximately UK £42 thousand pounds) from insurance companies as most of the damage sustained was to roads and stormwater systems which are not insurable. According to the observation local government have difficulties to get funding sources for public infrastructural insurance, simply because the previous government borrowed money from insurance companies, and the government is still trying to settle the debts.

1.5 SIGNIFICANCE OF THE STUDY

The study examines the challenges of flood risks and the impact it has on insurance companies in the GLM, within the context of South Africa. This quantitative study aims to produce flood damages figures, to provide input to current floodplain management practices and legal frameworks for insurance institutions. It informs local, provincial and national government and local communities regarding the severity, frequency and magnitude of flood impact on insurance companies. Relevant stakeholders and policy-makers should be informed of the flood risk impact on insurance for envisaged better decision making practices in human settlement choices. In addition to its local application, it can be used to assist the insurance companies and local authorities to better regulate floodplain settlement on the Sub-Saharan Africa/Africa and even internationally.

1.6 LIMITATIONS OF THE STUDY

The study focused on the GLM, and the focus was only on urban properties that have insured with insurance companies in the GLM. Priority was given to medium (R8, 000-20,000)-high (R30, 000 and more) income residential properties that are constructed on the floodplains and are continuously affected by floods, the South African Insurance Association (SAIA). The SAIA provided the study with houses that continuously had a record of claiming flood damages. Some houses were assessed by insurance companies and observed through transect walks, while in other instances, the local newspaper supplied photos that captured the damages to property visually. A key assumption of this research is that people who settle on floodplains in the GLM have insured their properties with the SAIA. The research considered medium and high income communities in particular.

1.7 PRELIMINARY LITERATURE REVIEW

A literature review was undertaken to describe the problem situation and the current state of knowledge on the topic to be investigated. Furthermore, Strauss (1993) and Sax, (1979) maintains that the literature study should establish the need for the research and indicate that the researcher is familiar with the area under research. The researcher, therefore, consulted with a variety of sources such as publications, journals, magazines, newspapers articles, dissertations and thesis which are relevant to the study. By consulting these sources, the researcher gained theoretical knowledge on flood risk and its impact insurance companies. Research method will be discussed later in chapter 3.

1.8 CONCLUSION

This chapter introduced the research question, which focus on the concern that flood risk insurance poses major problems globally. This study was motivated by the realization that there is a need to reduce flood impact Solutions on how to prevent, and mitigate flood damage could help curb the high annual insurance payouts. Flood risks therefore needs to be mapped and analysed to measure the degree of property damage or loss to the insurance companies. The insurance industries and the communities need to work together to reduce the impact of flood risks. The research question was formulated, followed by the objectives of the study, description of the study area, significance of the study, limitations of the study, and the literature review. Chapter 2 presents the results of the literature study, while Chapter 3 presents the research methodology in fine detail (with reference back to the literature review of chapter 2).

CHAPTER TWO

2. LITERATURE REVIEW

2.1 INTRODUCTION

This section is intended to impart general information about flooding that will provide a more in-depth understanding of the current literature and research concerning flood hazards, processes and policy making regarding risk reduction and risk management. It communicates a brief overview of the mechanics of flood disasters, as well as different types of floods and their unique characteristics. It is meant to be a review of information that not only comes from written literature but also from other sources including personal communication with specialists.

2.2 RAINFALL IN SOUTH AFRICA

Climate and rainfall data are readily available from the South African Weather Services (SAWS, 2011), which has forecasts for various sectors including but not limited to weather forecasts for the general population, aviation and shipping. Regional forecasts which include mainly rainfall predictions are also available from various independent weather forecasters and are published in local newspapers and electronic media throughout the world – one may even find websites in Europe providing detailed forecasts of rainfall patterns, wind direction and wind strength in local areas in South Africa.

Estimated 7percent of South Africa has a mean annual precipitation (MAP) exceeding 800mm, making it a generally dry area. The MAP has a large impact on South Africa's gross irrigation requirement, if the area is dry, it therefore means that irrigation infrastructure to be utilised would be costly, while the on the other hand wet land requires less irrigation systems (Schultze, Smith & Granam, 2001). The driest province is Northern Cape and the wettest KwaZulu-Natal, as depicted in Table 2. The Western Cape, received mainly winter rainfall while the rest of the country primarily received summer rains in the form of thunderstorms from October to March every year.

Table 2: Mean annual precipitation for the provinces of South Africa.

MEAN ANNUAL PRECIPITATION (mm)			
Province	**Mean Value**	**Maximum Value**	**Minimum Value**
Northern Province	-	-	-
Mpumalanga	736	1,933	341
North West	481	782	246
Northern Cape	202	540	20
Gauteng	668	900	556
Free State	532	1,689	275
KwaZulu-Natal	845	1,967	417
Eastern Cape	552	1,722	96
Western Cape	348	3,345	60

Source: Adapted from Schultze *et al.*, 2001.

Western Cape is the second wettest province in South Africa (Schultze, Smith & Granam, 2001); hence the GLM experiences more rainfall annually. The more rain the area receives, the more it increases the probability of flood occurrences, especially in heavily built-up areas. The high rainfall in the GLM is due to the costal land climate factors. Normally the storms last for one week, due to the sandy soil in the GLM, the water gets absorbed in the soil within two weeks Building on coastlines perhaps increase the severity of floods, e.g. due to people wanting to have sea-views, placing themselves inadvertently in the path of the weather systems that brings about this large amount of rainfall damage to their physical infrastructure. People settling in flood prone areas with (or without) proper mitigation measures always results into man-made disasters.

2.3 WHAT IS FLOODING?

Arup (2006) defines flood as a discharge causing damage, or a discharge overtopping riverbanks, or a discharge exceeding specific amounts of rain within a short period. The discharge is most commonly caused by heavy rainfall, but may also be caused on occasion by a dam burst. Typically, a flood can be divided into two broad stages (Wisner, Blacke, Cannon & Davis, 2006), namely a land and a channel phase. The land phase is the first phase when the soil or land covering cannot absorb all the water, and excess water causes run–off. This phase rarely causes significant damage to the environment, although pounding of water may cause inconvenience or minor damage e.g. small potholes in roads over long periods of inundation. That said, however, some low lying and level areas do experience significant damage and it poses a health risk when there are water ponds for long durations of time. Since this is not the case in GLM, however, it is not considered here as a factor. The run–off caused by the land phase flows into, or reaches, a river upon which the flood enters its channel phase, and this is normally when extensive damage may occur, if there is infrastructure in its way. The areas on the bank of the river that is inundated are called floodplains. The size of the floodplain will vary depending on the size of the flood (due to water velocity and depth), return period of the flood, soil and surface infiltration characteristics in the flood plain, waste build-up and restrictions to water flow, as well as the topography of the area surrounding the river (Lynch, Zulu, King & Knoesen, 2001). Floodplains are areas adjacent to rivers and streams that are subject to recurring inundation. Floodplains are therefore "flood-prone" and are hazardous to development activities if the vulnerability of those activities or structures exceeds an acceptable level. A "1:100-year flood" or "100-year floodplain" describes an event or an area subjected to 1 percent probability of a certain size flood occurring in any given year, within the period of 100 years. This does not mean that the area may not be inundated to the same level two years in a row – it is simply an indication of the probability of such inundation taking place. As development proliferates and surfaces become more and more impermeable, these probabilities similarly increase.

The South African National Water Act (Act 36 of 1998) (South Africa, 1998: 144) states that "for the purposes of ensuring that all persons who might be affected have access to information regarding the potential flood hazards, no person may establish a township unless the layout plans shows, in a form acceptable to the local authority concerned, lines indicating the maximum level likely to be reached by floodwaters on average once in every 100 years”. It should be noted that before 1998, the inundation levels were only required to indicate the average maximum 1:50-year flood lines, which are in many cases significantly less (i.e. narrower/smaller) than the now required 1:100-year levels. Some municipalities, such as the City of Tshwane, has taken pre-emptive steps in even defining the 1:200-year indicative flood plains for the metropolitan area, thereby allowing themselves to be guided by the potential effects of intensified urban densification and climate change alike. Perhaps the question therefore exist whether the GLM should follow a similar preventative approach and either delineate additional levels, or even go as far as prohibiting certain developments inside the 100-year flood line. This will not only limit the damages, but may also decrease the insurance companies’ mass loss due to flood damages.

The GLM may also have to start by identifying which types of floods affects its communities, then develop municipal by-laws that may address the flood risks. In Figure 1 the birth process of a flood is illustrated, listing the parameters that influence the extent of damage that may eventually be caused by the flood.

1. Event causing severe rainfall- Tropical cyclones

- Cut–off low pressure systems
- High pressure systems
- Large-scale near stationary wave patterns
- Intense cyclone mid–latitude systems
- Mesoscale convective systems

(complex of thunderstorms)

↓

2. Parameters affecting Flood size

- Size of catchment
- Distribution of rain over catchment
- Distribution of rain over time
- Intensity of rainfall
- Permeability of ground in catchment
- Antecedent catchment moisture status (State of 'wetness' of the catchment area)

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3. Characteristics of river molding the flood

a. Topographical qualities

b. Hydrological qualities

c. Geological qualities

↓

FLOOD

Figure 1: Birth process of a flood (Schultze *et al*., 2001).

Figure 1 indicates three processes that contribute towards the birth of floods. The first stage describes events that cause high rainfall in an area. This relates in the GLM in following ways: In GLM extreme cut off low and low pressure systems contribute towards high rain fall patterns. Stage two, explains the factors that determine the flood size. The GLM receives rainfall of about 250mm at times over a day, mostly during winter and spring. The intensity of rainfall is a contributing factor towards the flood size experienced in the municipality. Stage three, refers to the characteristics of river molding the floods. In the GLM, the rivers are seasonal throughout out the year. The topography is irregular, agricultural holdings, farmlands and alien invasive vegetation helping in water controlling during rainy seasons. Although the vegetation helps in controlling water most properties and developmental sites experienced huge damages from flood risks and the insurance companies suffer loss due to flood risks.

2.3.1 Types of flooding

According to SwissRe (1998), and Parker & Neal (1999), there are several different types of floods. The GLM experiences the followings flood types:

- Riverine flooding;
- Flash floods;
- Alluvial fans;
- Urban drainage;
- Ground failures;
- Mud floods;

- Subsidence;
- Storm surge; and
- Wave action.

The study indicates which types of floods are predominant in the GLM. When rainfall reaches the Earth's surface, water either gets captured in attenuation structures or dams, evaporates, infiltrates into the soil, or runs over the surface (*ibid)*. The kind of ground cover greatly influences the parts of each of these actions. In various types of communities, and within communities, there are different cover types. For example, an urban area, a city, might have these cover types (as in case with the GLM):

- Open space (lawns, golf courses, parks) generally covered with grass;
- Streets and roads;
- Paved parking lots and shopping centres;
- Houses and residential areas; and
- Offices and business areas.

The study indicates which types of floods are predominant in the GLM. If the rainfall intensity exceeds the storage capacity of the catchment, the evaporation rate and infiltration capacity of the soil, surface runoff occurs. It also occurs when rainfall falls on impervious surfaces, such as roadways and other paved areas, and cause direct run-off into storm water structures (Du Plessis & Viljoen, 1999). Water flows across the surface as either confined or unconfined flow. Unconfined flow moves in broad sheets of water often causing sheet erosion. It can also pick up and absorb or carry contaminants from the surfaces that it flows over. Water that flows along the surface may become trapped in depressions (other than man-made structures mentioned earlier). Here water may either evaporate back into the air, infiltrate into the ground, or spill out of the depression as it fills. If local drainage conditions are inadequate to accommodate rainfall through a combination of evaporation, or if the structures that hold water are filled in or cause to be ineffective due to waste filling it up, infiltration into the ground, and surface runoff; accumulation of water in certain areas may cause localized flooding problems (Parker & Neal, 1999; SwissRe, 1998).

Alternately, sheet flow may reach a natural or constructed water conveyance system such as a small valley, channel, or conduit (Salvesen, 2005). Water is conveyed to larger drainage systems such as creeks, streams and rivers. During winter and spring, accumulation of snow, even in some areas within the GLM, may increase water runoff generated by both precipitation and snowmelt (Lamb, 1991)

The flooding problems noted above resulting from runoff of surface water generally increase as areas become more urbanised. In the GLM, the seasonality of storms and rainfall patterns exacerbate this phenomenon. Greater population density generally increases the amount of impervious area, for example, through paved areas and building footprints. This reduction in the amount of natural ground that can absorb rainfall results in an increase in the amount of surface runoff generated. According to the Intergovernmental Panel on Climate Change (2001), if there are uncontrolled runoffs, this runoff may be channelled into areas that cause flooding of structures and roadways. These may be especially true where the predevelopment land surface had a gently sloping surface with no defined channels. Such areas are subject to shallow sheet flooding during storms, and urbanization and other development speed up the accumulation of floodwater in this type of flooding (Parker & Neal, 1999; Swiss-Re, 1998).

2.3.1.1 Riverine flooding

When surface water enters the streams and rivers exceeds the capacity of the natural or constructed channels to accommodate the flow, water overflows the stream banks, spilling out into adjacent low-lying areas. This results in riverine flooding. The photos presented in photo analysis page 125 shows this phenomenon on Groot Brak river, where water overflows the riverbanks, and run off to submerge roads and properties.

The dynamics of riverine flooding vary with terrain (Parker & Neal, 1999; SwissRe, 1998). In relatively flat areas, land may stay covered with shallow, slow-moving floodwater for days or even weeks. In hilly and mountainous areas, floods may come minutes after a heavy rain. The short notice, large depths, and high velocities of flash floods make these types of floods particularly dangerous. The common types of riverine flooding are: overbank flooding, which is when rivers and streams increase the volume of water in the river channel, and the overflow of water from the channel onto the adjacent floodplain (French, 2002). If not well manage, riverine flooding can destroy and damage physical infrastructure.

Riverine floodplains range from narrow, confined channels (as in steep river valleys in hilly and mountainous areas) to wide, flat areas (as in much of the Midwest and in many coastal areas). In the steep narrow valleys, flooding usually occur quickly and is of short duration, but is likely to be rapid and deep. In relatively flat floodplains, areas may remain inundated for days or even weeks, but floodwaters are typically slow-moving and shallow (Meier, 1988). In the GLM most properties are developed on floodplains and near rivers making it a high probability of flood affecting the local houses.

The GLM has a climate that can be described as a temperate, coastal climate with hot, humid summers, rainy winters. The GLM falls within a ‘uniform rainfall zone’, and receives rainfall throughout the year, with relatively high rainfall in winter and spring. The average annual rainfall varies from 866 mm per annum in the GLM to more than 1200 mm per annum; causing rivers to handle more water than its maximum capacity (Gibb, 1999).

2.3.1.2 Flash floods

The National Weather Service (2005) defines a flash flood as “a rapid and extreme flow of high water into a normally dry area, or a rapid rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g. intense rainfall or dam failure). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters (Crichton, 2007). Flash floods are also characterized by a rapid rise in water, high velocities, and large amounts of debris. Major factors in flash flooding are the intensity and duration of rainfall, and the steepness of a watershed and stream gradients. Flash flooding occurs in the GLM, most commonly in steeply sloping valleys in mountainous areas, but can also occur along small waterways in urban environments.

Flash floods in the GLM do occur without warning, causing residents to suffer the consequences of not having early warning and preventatives measures in place. In the 2010/2011 floods, there was fierce cut-off low weather system which was responsible for the current extreme cold weather and heavy rainfall in the GLM. During 2010/2011 (December-January), the GLM received an average of 250mm (millimetres) of rainfall within 24 hour.

2.3.1.3 Alluvial fans

Alluvial fans, which occur mainly in dry mountainous regions, are deposits of rock and soil that have eroded from mountainsides and accumulated on valley floors in a fan-shaped pattern (Crichton, 2007). This normally happens in wilderness and Outeniqua Mountains, where the roads will be filled with fine rock particles. The deposits are narrow and steep at the head of the fan, broadening as they spread out onto the valley floor. Fans provide attractive development sites due to their commanding views, but harbour severe flood hazards along with unique behaviour. Channels along fans are not well defined and flow paths are unpredictable. As rain runs off steep valley walls, it gains velocity, carrying large boulders and other debris. This then leads into shifting channels and combined erosion and flooding problems over a large area (Lynch *et al.*, 2001). In the GLM, alluvial fans affect the roads, causing traffic problems and delay in normal services deliveries.

2.3.1.4 Urban drainage

According to Van Dijk and Alexandra (2001), urban drainage problems occur when the water accumulated after the rain is not able to drain but increases in volume thereby causing floods. This is the reason for developing drainage in urban areas, so that the elimination of excess surface water after a rainfall and the containment and disposal of that water can take place as quickly as possible through a closed conveyance system. This means that no matter how large the rainfall or its duration, the drainage system is expected to remove runoff as quickly as possible. The cumulative effects of such an approach has been a major cause of an increased frequency of downstream flooding, often accomplished by diminishing groundwater supplies, as a direct result of urbanization; or has compelled the development of downstream measures to prevent flood damage (Du Plessis & Viljoen, 1999).

In the GLM some dwellings are built on the fringe of stormwater channels or directly opposite stormwater outlets. Run-off in channels worsened by dumping of household refuse, thereby impeding the flow of run-off, causing water to rise and spill over much faster. There are also homes that were built on a high water table, in close proximity to underground springs, with no or very few drains, which were often blocked. In some cases, houses were built directly under stormwater drainage outlets. In Thembalethu, some homes are located on lower part of the slopes, as a result of poor town planning. It is suspected that, this is due to constrained governance, reflected in poor regulation of building standards and municipal oversight of building contractors.

2.3.1.5 Ground failures

Flooding and flood-related erosion can result from several types of ground failures. Subsidence and liquefaction of soil may cause flooding of areas in the immediate vicinity of the ground failure, while mudflows and mud floods may cause damages downstream, or down slope, of the location where the initial ground failure occurred (National Weather Services, 2005). On the 18 May, 2011, Residents of the Plettenberg Bay, Knysna, Sedgefield, George, Mossel Bay, Prince Albert and in the Langkloof (Annexure A) experienced a light earthquake, which shook the grounds and relieved the internal pressure that damage the underneath infrastructures. The tremor was felt for at least five seconds. However these types of events occur in ten years in the cities (SAWS, 2011). Although the dolphin point mud flow onto the highway had nothing to do with an earth tremor, the researched just wanted to highlight such incidents in the GLM.

2.3.1.6 Mud floods and mudflows

Mudflow and mud floods (also referred to as debris flow) are considered a subset of landslides and affect many of the nation’s floodplains. The debris flows were experienced in the GLM in 2008. The National Academy of Sciences National Research Council (1985) defined mud flood and mudflow as a flood in which the water carries heavy loads of sediment (as much as 50 percent by volume), including coarse debris. Mud floods typically occur in storm water drainage channels.

Mudflows and mud floods may cause more severe damage than clear water flooding because of the force of the debris-filled water, and the combination of debris and sediment. The force of the water often destroys pilings and other protective works, as well as structures in its path (or when structures remain intact, sediment must often be physically removed through manual labour). Mud and debris may also fill drainage channels and sediment basins, causing floodwater to suddenly inundate areas outside of the floodplain. Although understanding of the causes of landslides and the development of improved methods for handling them has progressed, the problem continues to grow (Parker & Neal, 1999; SwissRe, 1998). In the GLM, the most common type of mudflow is debris flow, whereby debris falling from the slopes, to the roads and rivers.

2.3.1.7 Subsidence

Subsidence is a type of ground failure that can lower the ground surface, thereby causing or increasing flood damage in areas of high ground water levels, areas that are shallowly underlain up to 100m (mitres) by dolomite (CGS, 2007), where there are tides, storm surges or over-bank stream flows (Stevenson, 2003). According to Tol (2001), ground failure due to subsidence can result in increased flood damages for two main reasons. If the land surface is lowered, it may be more frequently (or more deeply) flooded. In addition, subsidence can block (or otherwise alter) drainage patterns, leading to deeper or unexpected flooding.

Subsidence is the result of both natural processes and human activities. Natural causes include solution (karsts topography), consolidation of subsurface materials (such as wetlands soils), and movements in the earth's crust. Human activities, which accelerate the natural processes leading to subsidence, include mining, inadequate compaction of fill material during construction, and withdrawal of oil or water from subsurface deposits (Benson, 2005).

The increase in damage can be related to the increase in population and construction of roads, passes, railways and housing developments. All mountain passes are vulnerable at times of flood and few escape damage. The Kaaimans Pass and the George to Knysna (Annexure A) railway line have been particularly prone to landslides, rock falls and subsidence, which occur at the same points in varying degrees with every flood (Western Cape, 2008).

2.3.1.8 Storm surge

According to Becker and Grunewald (2003), storm surge is the increase in water surface elevation above normal tide levels. This is due primarily to low barometric pressure and the piling up of waters in coastal areas, as a result of wind action over a long stretch of open water. The low pressure inside a storm or hurricane’s eye creates suction like a straw, creating a dome of water near the centre of the storm. In the deep ocean, this dome of water sinks and harmlessly flows away. But as a storm nears land, strong winds in the storm push this dome of water toward the shore, the rising sea floor blocks the water’s escape and it comes ashore as deadly storm surge. Burby (2001) mentioned that storm surges occur regularly in the GLM.

With a rise in sea-level and increase in frequency and intensity of sea storms, accompanied by an increase in wave heights, the South African coastline is expected to experience: greater risk of damage by storm surges, increased exposure to more intense and more frequent extreme events, increased saltwater intrusion and raised groundwater tables, greater tidal influence, increased flooding, with greater extent and frequency, increased coastal erosion, more frequent destruction of coastal property and infrastructure, periodic destruction or negative disruption of the coastal biosphere and environment (Becker and Grunewald, 2003).

On 19 and 20 March 2007 an extreme storm, coinciding with abnormal string tides, produced swells in the range of 8.5 metres that devastated the Western Cape coastline. The aftermath was significant coastal erosion and an estimated one million rand (which amounts approximately UK £8 million pounds) in damage to coastal property and infrastructure. The insurance companies had to pay for the damage to the coastal property. The effect on the coastal biosphere and environment went largely unmeasured. From past records it is evident that waves of around 7 metres in height are experienced every year along the South African coast, while big waves of over 10 metres are recorded every 20 years (Burby, 2001). It is alleged that flood damages have serious financial consequences on those individuals that settle on floodplains.

2.3.1.9 Wave action

Salveson (2005) mentioned that wave action is an important aspect of coastal storms. Breaking waves at the shoreline become very destructive, causing damage to natural and manmade structures by hydrodynamic pressure, battering solid objects and scouring sand from around foundations. Salveson (2005) also stated that components of wave action include wave set-up and wave run-up. Wave set-up is the super elevation of the water surface over normal surge elevation, and is caused by onshore mass transport of the water by wave action alone. Wave run-up is the action of a wave after it breaks and the water “runs up” the shoreline or other obstacle, flooding areas not reached by the storm surge itself. Where vertical obstructions such as seawalls are present, wave run-up is translated into upward movement of the water.

The southern African coastline from Maputo Bay in Mozambique, along the south coast, from the east of Angola to the west of Angola is uniquely characterised by strong wave action, especially in the southern Cape. There are wave actions in the GLM because are very small number of sheltered bays. This results into the area being constantly exposed to floods damage that insurance companies have to pay-out for the claims submitted by the property owners.

2.4 FACTORS THAT DETERMINE THE EXTENT AND AMOUNT OF LOSSES BY FLOODS

The individual damage progression which determines the scope and quantity of the losses are as speckled as the diverse aspects of the natural hazards of flooding (SwissRe, 1998). For the flood insurance companies to derive at an expected loss amount for a particular property the following factor will be taken into account:

- **Depth of water;**

Water can cause various types of damage. Absorptive materials may swell up and burst, which can result in electrical appliances short-circuiting. Metals can corrode, not to mention another damage-relevant factor is that flood waters always transport particulates that are burdened with chemical or biological substance. The higher the water level rises, the more property gets wet and the greater the resulting damage. This shows that the water level has a decisive influence on the amount of damage (*ibid*).

- **Water velocity;**

The current in a watercourse can erode banks and under wash buildings close by which can result in the collapse of the affected buildings. Typical current velocities in a watercourse on a low gradient are between three and ten kilometres per hour. Once water has left the river course, its current velocity declines unless there are special topographical conditions (*ibid*)

- **Transportation of debris;**

When flooding occurs, rivers transport large amounts of debris. Depending on the velocity of flow and the ground conditions, the rubble is composed of anything from gravel to sand (*ibid*).

- **Speed of rise; and**

The speed with which the flood waters rise is a major factor in loss mitigation. In the event of a cloud burst, the water can be meters high within seconds. This situation permits counter-measures to be undertaken, provided that the early-warning organisation functions (*ibid*).

- **Inundation periods**

After river flooding, the water can remain stagnant for weeks (*ibid*). The general rule is that the longer the water stands, the greater the losses are likely to be due to metals corrode, organic materials start to rot, poor mortars can disintegrate, germs multiply very swiftly depending on water temperature, and watertight buildings are torn from their moorings as a result of rising ground water(*ibid*).

Insurance companies always have to utilise the factors mentioned above to derive the cause of floods and the floods damage assessment. The above mentioned may be part of a flood insurance policy guidelines. However, the insurance companies may make mention of this factors to make the population aware of the factors that determine the communities individual premiums.

2.5 IMPACT OF FLOODS

Rainfall is a natural phenomenon whose occurrence can be erratic resulting in weather shocks such as floods which can have devastating impacts on the socio-economic, livelihoods of the people. Floods trigger a multiplicity of both negative and positive impacts to economies relying on rain-fed agriculture, and physical infrastructure. This study explores the possible short to long-term (economical, psychological, human health, agricultural and physical) impacts of floods to the well-being of the GLM. The floods, which were a result of constant heavy rains in a country which has become the sole breadbasket of Southern Africa, a former breadbasket still reeling in its political and economic challenges, claimed over a 100 lives, left 33 district municipalities declared disaster areas, left thousands of houses damaged and caused major agricultural and physical infrastructure damage. Against such a background, one feels compelled to speculate the effects of weather shocks in form of floods to such an economy in terms of employment, income, food security, food prices and property.

2.5.1 Economic impact

Tubin & Montz, (1994), Montz & Tubin, (1998) are evaluating how extreme floods affect real estate prices. So far, their work in places called Linda and Olivehurst, in California, indicates that residents with the most severe flooding do see a long lasting impact on the house price. Homes with limited damage seem to be unaffected. In fact insurance companies increase premiums in some homes if the houses submit claims due to the fact that the insurance company have to replace all the appliances, paint and carpets.

The houses increase in value to reflect the improvements. The results show clear spatial variation across the cities. After a disaster, the community goes through four phases that overlap: the emergency period, the restoration period, the replacement reconstruction period, and the commemorative betterment period (Haas, Kates & Bowden, 1977). Each phase is depended on the completion of the previous. The rate of recovery is directly related to the extent of damage, the available recovery resources, the prevailing pre-disaster trends, and community leadership and planning (*ibid)*. These phases can be used as a general planning guideline for community officials. Maybe the GLM should enforce the general planning guidelines, to the insurance companies and the community. This might reduce the flood claims on the insurance companies.

According to Wisner *et al.* (2006), the impact or consequences of flooding depend on both the nature of the flood and the area affected. Floods have a devastating effect around the world (SwissRe, 1998). Flooding can also have significant financial implications for individuals, businesses, local communities, and regional and national governments. However, it is not technically feasible or economically affordable to prevent all flooding. Table 3 summarizes the impact of floods internationally, especially in the United States of America, the United Kingdom and South Africa.

Table 3: Floods impact in the United States of America, United Kingdom and South Africa.

Country	United Kingdom (UK)	United States of America (USA)	South Africa (SA)
Areas at risk	Storm surges can occur in coastal areas. Inland river floods. Dam burst at Older reservoirs. Flash floods in densely Populated areas.	River flooding: The central part of the USA is at risk of severe flooding by the Mississippi and Missouri rivers. Flash floods due to heavy local rainfall. Storm surges following hurricanes.	Flooding as a result of heavy rain falls. Flooding as a result of Tropical cyclones. Cities at risk: Cape Town, Port Elizabeth, East London, George, Durban and Pretoria Flash flood resulting from storms and torrential rain falls.
Events and loss figures	1998: Floods in England, estimated insured loss: United States Dollars 250 Million 1997: Scottish rivers overflow, estimated insured loss: United States Dollars 98 million 1994: Floods in southern England, estimated insured loss: United States Dollars 100 million 1990: Heavy storms and floods at north west coast, estimated insured loss: United States Dollars 123 million	1997: Flooding (state of California, Washington, South Dakota, Minnesota), estimated insured loss: United States Dollars 205 billion 1995: Flooding (California, Washington, Texas, Nevada) estimated economic loss: United States Dollars 2.1 billion 1992: Flooding (Northeast, Texas,) estimated economic loss: United States Dollars 2.85 billion	2011: Flash floods in south Africa, economic loss United States Dollars 365 million 1996: Heavy rain falls and flooding in North West, estimated economic loss: United States Dollars 35 million 1995: Flash floods in Pietermaritzburg, estimated economic loss: United States Dollars 10 million 1987 to 1988: (Natal floods, Free state and Northern cape), Insured loss United States Dollars 320 million

Source: Adapted and combined from SwissRe (1998) and COGTA (2011).

Even though South Africa is not as affected by floods as other countries, such as the United States of America, floods still have devastating effects whenever they occur (SwissRe, 1998). Table 3 presents a comparison between the UK, USA and SA in terms of the area at risks, the flood events and the loss figures resulting from floods damage.

The 2011 floods had devastating loss figures around South Africa. The GLM flood loss was recorded estimated R32 million (which amounts approximately UK £27 million pounds) The GLM was able to claim approximately R500 000 (which amounts approximately UK £42 thousand pounds) from insurance companies as most of the damage sustained was to roads and stormwater systems which are not insurable. Private properties which were insured were able to be disaster resilient after the insurance pay-outs. The non insured properties, requested financial assistance from the local government.

2.5.2 Psychological impact

More recent research has attempted to quantify the lasting post-traumatic stress syndrome on individuals in disaster-impacted communities (Tobin & Ollenburger, 1996; Erickson, 1998). For example, a study of suicide rates before and after disasters indicated that suicide rates rose 13.8 percent in the four years after floods (Krug, Kresnow & Peddicord, 1998). However, the research did not dwell much on psychological impact, but highlighted, that they might be psychological impacts after a flood event.

2.5.3 Human health impact

Floods are known to transmit diseases to humans as a result of poor hygiene (Du Plessis & Viljoen, 1999). Diseases that are known to be transmitted during floods are communicable disease (malaria and diarrhoea) and floods can also result in fatalities (Van Dijk & Alexandra, 2001). It was found that in South Africa more than 500 people have died from drowning during floods since 1970. Floods are also associated with famine periods as they have an impact on agricultural products.

Key health facilities in the area include a regional hospital in George City and two private hospitals, Geneva Clinic and George Medi-Clinic. The municipality operates eight community health centres / clinics throughout George, i.e. the Blanco, Parkdene, Rosemoor and Lawaaikamp clinics and the Community Health Care Centres at Conville, George Civic Centre, Pacaltsdorp and Thembalethu (George Local Municipality, 2005).

Some of the GLM well developed private health services have evolved because of the influx of high-income (pre-) retirees into the area and the ability of that segment of the population to afford top-class facilities. The GLM also plays an important role as a regional (Southern Cape) health-service centre. These facilities are however, not necessarily available to low-income households who need basic services. Health services at outlying places in the GLM are far less developed, particularly in rural settlements, and will thus need special attention in the future. Existing demands for social facilities are not met, largely as a result of funding constraints. The GLM's health-services sector is in many ways a regional facility, with the capacity strained by much more than just local demand (George Local Municipality, 2005). Floods can make health institutions be cut off from the community, which could lead to health facilities being inaccessible when they are needed most by the local community.

2.5.4 Agricultural impact

According to Kunreuther and Michel-Kerjan (2006), livestock and grazing are mostly affected by floods. Livestock lack a place where they can feed, as their grazing land is covered by water. Furthermore, the livestock contract several diseases, such as foot and mouth disease in cows. Other livestock die by drowning in water. Moreover, FAO (2004) stated that flood damage has a huge impact on plant production, as most plants are destroyed. According to Usman, Archer, Johnson & Tadross (2005), the floods in eastern Australia are estimated to have reduced agricultural production by at least US $500–600 million in 2010-2011, with a significant impact on the production of fruit and vegetables, cotton, grain sorghum, and some winter crops. Floods have had an influence on the increase of food prices.

Agriculture is a major land use in the municipal area outside the town of the GLM, covering a large percentage of its land, particularly west of the town. Forestry in the municipality includes both commercial forestry (managed predominantly by Mountain to Ocean) and indigenous forestry areas. Commercial forestry takes place predominantly in the undulating foothills between the mountainous areas far north and the plateau, where topographic (steep slopes), soil (deep, fertile soils) and climatic conditions (high rainfall) are most suited to forestry activity. Indigenous forests occurs to a lesser extent, with the largest pockets of indigenous forest located in the undulating hilly areas east of the town, becoming more dense towards the GLM (George Local Municipality, 2005). The ‘tension’ between the expansion of the town and the scarcity of high potential remaining farm land - It is feared that the expanding town would continuously take up valuable agricultural land. Agricultural lands are normally affected negatively by floods since plantations and animals get submerged in water for longer periods, thus make insurance companies to pay-out for all the damaged caused by floods.

2.5.5 Physical impact

Existing infrastructure and service networks in the GLM, including roads and engineering, water and sanitation, electricity supply, waste disposal and telecommunications are still at a developing stage. From disaster management perspective, the emphasis is on the ability of existing infrastructure capacities to meet current as well as foreseeable future needs as well as minimizing wastage.

Extensive losses have occurred in residential districts in floodplain areas. In many areas, more modern properties are especially badly affected, since these have a higher tendency to be located on flood plains (Scott, Jones & Mitchell, 2003). Loss of contents is particularly high, especially in single storey properties such as bungalows or ground floor apartments. Structural failure has been more common in upstream areas (such as in Austria and the Czech Republic) and close to the river channel, where water velocities have been higher (National Weather Services, 2005). This leads to more expense, due to the cost of repairing the damaged infrastructure and rebuilding the collapsed buildings. Therefore, the maintenance of the infrastructure is vital in the GLM, to mitigate the impact of floods.

2.6 TYPES OF FLOOD INSURANCE INTERNATIONALLY AND IN SOUTH AFRICA

There are a variety of flood insurance solutions available in all countries. The government and private insurers provide comprehensive covers in a variety of costs. Insurance companies cover house contents, properties and cars holistically. The scope of cover provided ranges from very restrictive to unrestricted (SwissRe, 1998). Table 4 provide information on flood insurance for the UK, USA and SA in a standard form under the following headings: areas at risk, events and loss figures, loss potential and types of insurance companies.

Table 4: Comparison between UK, USA and SA flood insurance.

Country	**United Kingdom**	**United State of America**	**South Africa**
Insurance carriers	Only private insurers, no state insurance	The NFIP set up in 1968 is the only Federal insurance scheme for natural disasters in the US. NFIP provides basic cover. Additional cover is available from private insurance companies	Private insurance companies, no state programme for national perils
Available cover/insurance terms and conditions	Flood insurance cover is generally included in homeowners and households contents policies Premiums rates are often high for storm/flood Flooding due to dam burst is covered Industrial risks: cover is available either in fire and named risk policies or in all-risk policies	NFIP: The vast majority of buildings and contents in an eligible community is insurable under NFIP. The insurance covers losses through river or flash flooding, erosion, subsidence and storm surge Deductibles applies for buildings and contents Premiums are high and vary in line with floods and risk quality Private insurance: additional cover is available on individual terms	Natural perils can be covered by means of an extension package to the standards fire policy There is a market tariff for flood losses, but not often adhered to. No risk-reflecting premiums for flooding Co-insurance and deductibles are rarely used.

Source: Adapted from SwissRe, 1998.

Most of the residents in the GLM have flood insurance covers while the poor communities such as Thembalethu rely on the government relief funds. Individual house owners have specifications, in terms of how much they are covered for in case of flood loss. There are no additional costs, on the house insurance, to include flood insurance.

2.7 THE SHORT–TERM INSURANCE INDUSTRY

Insurance represents an important method of meeting the financial consequences of risk. It has been traditionally defined as the business of transforming event (insurable) risks by means of a two-party contract. Insurance provides a mechanism for the transfer of the cost of risk rather than the transfer of risk (Valsamakis, Vivian & Du Toit, 2005). An insurance contract is a contract in which one party purchases the right to be compensated by another party for specific losses above an agreed-upon level in a particular state of the world. Insurance companies are risk transformers. Their business is the supply of financial innovations to their customers that allow those customers to transform their risks (White & Richards, 2007).

Short-term insurance is defined in the Short-Term Insurance Act (No of 53 of 1998) as providing benefits under short-term policies, which means engineering policies, guarantee policies, liability policies, miscellaneous policies, motor policies, accident and health policies, property policies, transportation policies, or a contract comprising a combination of these policies (*ibid*). Households buy insurance to transfer risk from themselves to the insurance company. The insurance company accepts the risk in return for a series of payments, called premiums. In the insurance industry, underwriting is the process used by insurance companies to determine whom to insure and what to charge. During a typical year, insurance companies collect more in premiums than they pay in claims. In the GLM, if there are flood damages, the insurance will make more profits.

2.8 TYPES OF COVERAGE AVAILABLE UNDER A FLOOD INSURANCE POLICY

In South Africa, flood insurance policies cover the loss of value of the physical building (Gavin, Reid & Scott, 2005). Coverage of personal belongings is based on the policy one opts for. Therefore, before deciding on which policy to buy, one needs to make sure that all personal belongings are protected by the policy. According to (*ibid*) the following are considered when purchasing a flood insurance policy:

2.8.1 Building property coverage

This type of policy covers the insured building, electrical and plumbing systems, furnaces, water heaters, centralized air conditioning system, cooking stoves, refrigerators, built-in appliances, window blinds and debris removal. This coverage indemnifies against permanently installed cabinets, panelling, bookcases, wallboard and carpeting. Garages outside the building can be covered for up to 10 percent of the building property coverage, while a separate policy is required to cover structures outside the building other than garages, such as gazebos (Penning-Rowsell, Johnson, Tunstall, Morris, Chatterton & Green, 2005). In the GLM the property insurance coverage is inclusive in the bond payments.

According to Hulse (1997), it is recommended that all residential and non-residential buildings which are more likely to be vulnerable to floods and water damage must at least have two rigid walls. These should be anchored and primarily above ground (defined by at least a 1:50 year flood line). Ferguson (1996) stated that it is best to avoid the construction of houses and development on the most hazardous land zones. According to Krauss (1997), if the above-mentioned mitigation measures can be implemented in the GLM, the impact of floods on insurers will be less, as well as on the community members who don’t own insurance policies but are settled in flood zones areas. According to Watson (1997), the regular programme offers flood insurance at actuarially determined rates.

2.8.2 Personal property coverage

This type of coverage compensates against the loss of personal belongings, such as furniture, electronic equipment and clothing. It also covers curtains, air conditioners (both window and portable), washing machines and dryers, portable microwave ovens and dishwashers, food freezers (including stored food), and carpets that were included in the building coverage. Furs, original artwork and other such valuable items can also be covered. In the GLM, this type of insurance is optional when one has car insurance.

2.8.3 Price distribution for flood insurance policyholders

Homeowner’s insurance premiums are based on the type of construction, size of the building and the location of the building. According to Vaughan and Vaughan (2001), premiums for flood coverage depend on the location of the property. The highest premiums apply to property on floodplains, especially near oceans. The insured value of the property is the rate per rand of insured value. Policies are generally initially insured with a dwelling limit equal to 100 percent of the dwelling’s estimated replacement cost.

The replacement cost per square foot is multiplied by the home's square footage to find a base replacement, which is multiplied by location modifier to arrive at the replacement cost used for establishing flood premiums (Harrington & Niehaus, 1999). In the GLM, considerations the location of the property is not taken into account in the premiums allocation.

2.8.4 Determinable probability distribution of flood insurance

According to Athearn, Pritchett and Schmit (1989), for an exposure to loss to be insurable, the expected loss must be calculable. This means that there is a determinable probability distribution for losses within a reasonable degree of accuracy. Flood insurance companies are based on predictions of the future, which are expressed quantitatively as expected losses and are derived from estimated probability distributions. Some probability distributions can be derived from theoretical relationships, such as the outcomes expected when a die is rolled. Other distributions, however, must be calculated from experience.

Probability distributions based on experience are useful for prediction, however, only when it is safe to assume that factors shaping events in the future will be similar to those in the past. When the probability distribution of losses for the exposure to be insured against cannot be accurately calculated, the risk is uninsurable. If losses cannot be predicted accurately and with confidence, it is impossible to determine either flood insurance premium rates or the size of surpluses required (Athearn *et al*., 1989). In the

GLM, the insurance companies have not yet determined the individual property premiums and the degree of exposure to flood occurrence. The more an individual house owner claims for flood damage, the higher the premium on their next instalments towards the home property insurance.

2.8.5 Flood insurance on property

According to Huber (2004), it is difficult, if not impossible, to privately insure against natural hazards. The difficulties are related to the fact that the threat is considered by the potential insurance population to be too remote to invest in insurance. Only those property owners, who are aware of being exposed to floods frequently, and with severe consequences, may consider purchasing insurance. An insurance population based on these assumptions, makes natural hazards a bad risk for insurance. Opposite to normal insurance coverage, natural hazards do not generate numerous small claims over a certain period but all claims are focused around the occurrence of one single event. If, potentially, all insured claimed compensation at the same time, funds would be emptied. If another event were to occur before the fund had re-accumulated the necessary means, the solvency of insurance companies would be under pressure.

SwissRe (1998) stated that the re-insurer claims that floods can be insured privately only if two conditions are met: the state and the insurance industry promote risk awareness among the potential risk population, and they “promote solidarity between those who are seriously at risk and those who are barely at risk”.

In the GLM, the level of risk awareness and solidarity determines the insurability of natural disasters. The main difficulty, however, is that these conditions cannot be obtained under market conditions. Customers do not want to subsidize the protection of others, but if insurance coverage for the exposed groups is costly, the market penetration remains low and raises the price for protection even further (Kunreuther, 1978; Palm, Hodgson, Blanchard & Lyons, 1990).

2.8.6 Government subsidizing flood insurance premiums

According to Harrington and Niehaus (1999), the government subsidizes insurance rates; it can often be criticized because it will encourage people to develop property on floodplains beyond the point that is justified if one were trying to minimize the cost of risk. This means, because of subsidized flood insurance, people who develop property in flood plain areas do not pay the full costs associated with the development. In effect, the insurance is only available to residents who have taken appropriate safety precautions that will help to reduce the expected loss (Penning-Rowsell & Chatterton, 1997). One justification for subsidized flood insurance is that there are many low incomers who would not purchase flood insurance if it were fairly priced. These people, however, would obtain disaster relief following a flood and thus, they ultimately might obtain insurance at no cost.

Despite flood insurance premiums being low, many eligible residents fail to purchase insurance from insurance companies (Harrington & Niehaus, 1999). One explanation is that they underestimate the expected loss resulting from floods, and therefore view the price as excessive despite the subsidy. The incentive to purchase flood insurance may be reduced due to the disaster relief that is often available following major floods. A factor that results in low flood insurance profitability is the frequency and severity of loss resulting from annual floods. In the GLM, government does not subsidise flood property damages but the insurance companies compensate the property owners.

2.9 FLOOD INSURANCE POLICIES INTERNATIONALLY

Baulware (2009) mentioned that insurance companies are governed by laws and policies that the state produce for disaster management. Internationally, the National Flood Insurance Programme and European Flood Directives have been developed to govern the insurance of properties in high flood zone areas. In South Africa, flood management is governed by policies that fall under the Disaster Management Act, No 57 of 2002.

2.9.1 Brief overview of the National Flood Insurance Programme of USA

The National Flood Insurance Programme (NFIP) was created in 1968 in response to the claim by private insurers that flood peril is uninsurable. The insurers argued that adverse selection would be a problem with only those in high hazard areas purchasing coverage; that risk-based premiums would be higher than any homeowner would be willing to pay; and that enough premiums could not be collected to cover the most catastrophic flood events (Anderson, 1974; Browne, 2000). A government programme might be successful since it could pool risks more broadly; have funds to jumpstart the programme; subsidize homeowners currently residing in hazard-prone areas; and tie insurance to land use regulations and building codes that would lower risks (Anderson, 2002). The NFIP, part of the Federal Emergency Management Agency (FEMA) of USA, was designed as a partnership between the federal government and local communities. In exchange for homeowners and businesses being able to purchase flood insurance, local governments adopt a minimum set of floodplain management policies. In the GLM, the insurance companies do not share financial responsibility with either the business or the government.

To set premiums, FEMA divides participating communities into varying flood-risk "zones" that are displayed on Flood Insurance Rate Maps (FIRMs). Premiums are set for each zone nationwide (GAO, 2008). They do not vary by region or community, but only by flood zone and characteristics of the property, such as its height above the base flood elevation (Crowling & Hilton-Tylor, 1994). To make programme implementation feasible, properties in place before a community was mapped, so-called RDP (Reconstruction and Developmental Programme) properties in the GLM context, receive subsidized rates. This is to encourage communities to join the programme and to not penalize homeowners who had built in the floodplain without knowing the risk, and who would otherwise face high rates and a decline in property values (Pasterick, 1998).

It was thought the subsidy would phase out quickly as houses were damaged or improved, but around a quarter of all properties are still subsidized, since modern construction techniques have extended the life of buildings (Black, 2005; Congressional Budget Office, 2007; Best Company, 2008). The total amount of the subsidy has decreased over time, however, as FEMA raised rates on these properties between 1981 and 1995. Despite the perception at the time the NFIP was created, that simply the availability of flood insurance would lead those at risk to purchase it, take-up rates for flood insurance have historically been quite low.

In 1972, Tropical Storm Agnes resulted in more disaster assistance being paid by the federal government than any previous storm. This was because only a few of the affected communities had joined the NFIP and very few properties that suffered damage were insured (FEMA Federal Insurance and Mitigation Division, 2002). By the end of 1973, fewer than 3,000 out of 21,000 flood-prone communities nationwide had entered the NFIP, and less than 275,000 policies had been sold to homeowners in these areas (Kunreuther, 1978). This slow beginning led Congress to pass the Flood Disaster Protection Act of 1973, which made flood insurance mandatory on any mortgage from a federally insured or regulated lender, for any property located in a 100-year floodplain (N M State University, 2005). In the GLM, there are RDP houses that get subsidized by the government, but the government does not have a programme to subsidize the affected families when they experienced floods. However, the local Housing Department will seek grants from National Treasury for infrastructure rehabilitation and reconstruction.

2.9.2 European Union Flood Directives

The European Union (EU) seeks to make it compulsory for all member countries to establish flood hazard maps along the lines of those being developed in France and Germany. This provision is described under a proposed Flood Directive (Takeuchi, 2002). The objective of this Directive is stated as: “To reduce and manage flood-related risks to human health, the environment, infrastructure and property.” It proposes “concerted action at Community level” and says, “The Water Framework Directive 2000/60/EC2 (WFD)(Europe) introduced the principle of cross-border coordination within river basins, with the objective of achieving good quality for all waters, but it set no objective on flood risk management” (Tavendale & Black, 2003). This is not, strictly speaking, correct as the WFD actually talks about “good ecological status” rather than “good water quality”. Good ecological status would include levels of flow (or lack of it), in other words flood or drought. It has been argued that there is no need for a separate flood directive. On the other hand, the WFD has already been used in England as a reason to prevent some non-structural flood management, such as the modification of rivers and lakes to provide increased flood storage (Roaf, Crichton & Nicol, 2005). In the GLM, the re municipal by laws, which try to reduce and manage flood risks to infrastructure, property, environment and human health, but it’s difficult to implement since there is lack of enforcement from the city planning and local department of housing.

2.10 GOVERNMENT POLICIES AND LEGAL FRAMEWORK THAT GOVERNS FLOOD RISK INSURANCE IN SOUTH AFRICA

Flood risks are governed by many government policies at a national level in South Africa. The following legal frameworks seek to advise the flood risk and their impact on flood insurance companies:

2.10.1 The National Disaster Management Act, No 57 of 2002

The Disaster Management Act, (Act 57 of 2002) encourages all stakeholders to participate in risk reduction programmes. By doing that, the GLM will decrease the level of floods impact on the insurance companies, resulting into insurance industries having fewer flood damage claims per annum. The policy is an integrated act that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters, and post disaster recovery.

It aims to assess, prevent and reduce the risk of floods by doing the following: determining the level of risk, assessing the vulnerability of communities and households to disasters that may occur, increasing the capacity of communities and households to minimize the risk and impact of disasters that may occur, and by monitoring the likelihood of (and the state of alertness to disasters that may occur. Effective flood risk assessments and risk reduction programmes can assist in reducing flood risks in the GLM.

The Act recognizes that policies are not functional without the involvement of all government spheres, the private sector, non-governmental organizations, communities and insurance industries. The integration of prevention and mitigation methodologies with development plans, programmes and initiatives, must be deployed. The Act is currently under review, and may address issues of how insurance companies and the local government can assist lowering the development of floodplains to reduce the negative impacts of floods in the GLM.

2.10.2 The National Disaster Management Framework of 2005

The aim of the National Disaster Management Framework of 2005 is to reflect a proportionate emphasis on disasters of different kinds, severity and magnitude that occur, or may occur, in the GLM. Also to place emphasis on measures that reduces the vulnerability of disaster-prone areas, communities and households. The National Disaster Management Framework of 2005 serves as the mother-body of all the disaster management policies in South Africa.

2.10.2.1 Principles of risk reduction

The National Disaster Management Framework of 2004 states that the disaster management plans by municipalities must give explicit priority to principles in flood risk reduction. In the GLM, flood risk reduction initiatives are given priories in the GLM disaster management plans but the implementation is unsuccessful that’s far. The aim of risk reduction is to lessen the impact of floods on communities. Methodologies to identify flood risks must be taught at schools and in community meetings, in order to educate the public about the negative impact of settling in flood prone areas.

2.10.2.2 Disaster prevention and mitigation

According to the NDMF, flood disasters can be prevented through effective land-use planning, as well as enforcement of municipal by laws that discourage wrong land-use practices. For example, the GLM should strategically position storm water drainage and conduct ongoing maintenance routines, so as to prevent destructive flooding during heavy rains, the flood impact on the community and insurance industry can be lowered.

Disaster mitigation attempts to prevent hazards from developing into disasters, or to reduce the adverse impact of hazards on vulnerable areas, communities and households (Haddow, Jane & Bullock, 2004). Alexander (2002) stated that the mitigation must focus on long-term measures for reducing or eliminating the risk. The implementation of mitigation strategies can be considered a part of the recovery process if applied after a disaster occurs (Haddow *et al*., 2004). This implies that developmental plans throughout the GLM must address flood risk long term measures, to avoid being reactive to flood damages.

2.10.3 The Local Government Municipal System Act, No 32 of 2000

The Municipal System Act, (Act 32 of 2000), Chapter 5, Section 26 (a-g); provides for the establishment of a simple and enabling framework for the core process of planning resources, and resource mobilization. The policy is capable of integrating the activities of all spheres of government, for the overall social and economic upliftment of the community, in harmony with their local natural environment.

The core components of the integrated development plan for the municipality must reflect the following:

- Applicability of disaster risk management plans - As a requirement of the disaster risk management act, every municipality must include disaster risk management plans in their integrated development plans (IDP). The IDP's must also aim to address the following: comprehensive disaster risk assessment, integrated disaster risk reduction, integrated disaster response and recovery, integrated information management and communication, integrated disaster risk management education, training, public awareness and research, and adequate funding arrangements for disaster management;
- An assessment of the existing level of development in the municipality, which must include an identification of communities who do not have access to basic municipal services. According to this Act, and the Disaster Management Act mentioned earlier, the GLM is encouraged to identify hazards via community participation. It is

advisable for communities to be involved in the risk identification process, in order to reduce the impact of future disasters;

A Spatial Development Framework (SDF) must be deployed in each municipality disaster management plan. This must include the provision of basic guidelines for the land use management system for the community. It is important to incorporate disaster prevention and mitigation policies in municipalities' plans. By doing that, the municipalities' should be focused on the improvement of disaster risk assessments and early warning systems. There is a need to build a culture of prevention, and to integrate prevention measures, in sustainable development policies.

The GLM must adapt to the Hyogo Framework for action 2005-2015, and in so doing, they must all adopt the following four priorities: ensure that the disaster risk reduction is a municipal and a local priority; with a strong institutional basis for implementation; Identify, assess and monitor disaster risks, and enhance early warning systems; use knowledge and innovation to educate towards a culture of safety and resilience at all levels and strengthen disaster preparedness for effective response at all levels.

The GLM should recognize the importance of risk identification in their risk assessments, which will educate the public on how to prepare, prevent and mitigate flood risks, so as to reduce the economical strains.

2.10.4 The National Building Regulations and Building Standards Act, No 103 0f 1977

According to the National Building Regulations and Building Standards Act, (Act 103 of 1977), the act provides for the promotion of uniformity in the law relating to the erection of buildings, in the areas of jurisdiction of local authorities. The policy serves as a municipal guideline in terms of the erection of properties in the GLM. It is in line with the disaster risk reduction measures, as it encourages people to settle in less disaster prone areas and insure their properties when settling in flood prone areas.

Section 29(2) and 29(8) (a) of the Act, states: “No building may without the express permission of the municipality be erected so that the building is, at the nearest point to a natural watercourse, nearer to the centre of the natural watercourse than a line indicating the maximum level likely to be reached every fifty years on average by flood water in the watercourse”. But there are no fines or consequences mentioned for the encroaching of this law, since people settle below flood lines in the GLM.

Section 10 (b) of the Act states that “buildings must not be erected on sites which are subjected to flooding without consulting with the local authorities. Every municipality must make sure that each building has proper drainage systems and the land is suitable for residential development. When proper consultation with the insurance industries and the local municipality is not done, flooding can setback development.”

This means that property owners should consult with the GLM regarding developmemts in the floodplains. The insurance companies and the GLM could also play a role in making the homeowners that aware that floodplains are a high risk to flood risks. In this case local government does not want the insurance companies loosing lots of money due to houses damages when floods occurs.

2.10.5 The Short-Term Insurance Act, No 53 of 1998

According to Rejda, Luthardt, Ferguson, and Donald (1997), the establishment of land uses and the construction of regulations can reduce the potential for flood loss.
The government established both the Short-Term Insurance Act (Act of 1998), which govern and regulate financial loss due to man-made and natural hazards. The Act provide for the issuing of insurance to communities, who have adopted certain land use and control measures.

The Act furthermore provides for the registration of short-term insurers, as well as for the control of certain activities of short-term insurers, and intermediaries. The act does not give clear guidelines in terms of flood damage insurance. In fact, the GLM private companies are the ones that cover a wide range of natural and man-made disasters; hence flood claims are claimed from private insurance industries than the government.

When comparing this Act, and the America's NFIP, the NFIP currently offers several flood insurance products, such as a dwelling policy, a flexible risk policy, and an independent insurance broker's policy. Amrhein *et al.* (1996) believe that the programme's primary purpose is to actively involve communities to help control and mitigate their vulnerability to flood losses, while in the GLM; individual home owners manage their flood risks. Hamilton and Malecki (1994) stated that the reason for offering flood insurance is to reduce the number of applications for flood recovery funds, after a flooded area has been declared an emergency state. Prohibiting developmental activities in flood prone areas requires hazard proof materials and methods.

In the GLM, property owners can reduce their own risks quite easily; simply by avoiding property construction below the 1:50 year flood line. The insurance regulator should issue guidelines which set out their risk-based strategy for auditing insurers, on operational risks. This could lead to insurers fearing that if they have too much business in flood hazard areas, they could be subject to audit by the SAIA.

2.11 A THEORETIC MODEL ON HOW INSURANCE SHOULD FUNCTION IN DISASTER MANAGEMENT

According to Queensland Government (2002), several institutions have developed methodologies designed for flood risks in their specific domains; however, there is no standard procedure to determine an accurate global figure for flood risks impact yet. Nevertheless, in 2009 the European Union inaugurated the 'damage' project in response to the need of European civil protection services to have a common methodology for the evaluation of damage produced by flood disasters. An appropriately designed disaster insurance program is vital for stemming the tide of increasing losses from natural disasters while at the same time providing funds to those suffering losses. The followings steps were developed and rolled out in the European Union and it was a success in managing and reducing floods.

2.11.1 Identification and analysis of flood risks

A careful identification methodology of the community property operations, assets and exposures must be conducted. This will highlight the losses which the community faces, as well as their probability and potential severity. The disaster analysis must not only focus on physical assets which are threatened by flood damage, but also home furnishings and inherent tangible materials. This could possibly include people, government, and interruption of the community's commercial and agricultural activities (Gordis, 2000).

2.11.2 Analysis of the flood risk management techniques

After the local people have identified all flood risks, possible alternative prevention or mitigation methods must be identified and pre-analysed. Internal and external systems, such as inventory and material flow check, record keeping, people's past experiences, check lists, and similar systems must be evaluated with an eye on minimizing possible losses (*ibid*).

2.11.3 Loss prevention

Techniques and programmes for preventing or reducing the impact of floods must be studied and analysed; then made available to the relevant policy makers (*ibid*).

Standard procedures must also be established to avoid the severe impact of floods. The flood risk management techniques already in operation must be reviewed and monitored periodically, to assure their efficiency under the ever-changing extreme weather conditions (*ibid*).

2.11.4 Flood risk avoidance

After all the potential hazard areas have been identified, it may become apparent that certain risk impact may be avoided by changing some community practices. Thus, the town planners, who plan for the infrastructure of housing, must decide after proper consultation with other involved stakeholders', on the construction of houses on any land. People must also learn to avoid settlements in disaster prone areas, in order to eliminate the severe impact of disasters (*ibid*).

2.11.5 Retention of flood risks

The most advanced techniques for avoiding or minimizing risk cannot eliminate flood risks entirely. It's vital to distinguish those risks, which threaten the economical stability of the community from those lesser exposures, which can be met without undue financial strain. The latter type of risk needs to be shifted to a risk-bearing institution, but may be retained by the community (*ibid*).

Even when floods are potentially large-scaled in scope, the community may safely retain small losses and damages. Short-term insurance policies can be drawn up to pay only amounts which exceed a stipulated sum. Economies in premium will result, and these should exceed the amount of uninsured losses (*ibid*).

The size of the loss, which can be judiciously retained, will depend on the nature of the community infrastructure and the amount of its tangible assets. Communities, which are geographically dispersed, may safely retain relatively substantial exposures at an individual location. This is because in relation to the overall size of the community, damages or loss at any single location should not prove unsettling. A properly structured retention insurance activity also includes the monitoring of the risk, as well as the safety and loss prevention services provided by a regular insurance organization (*ibid*).

2.11.6 Utilisation of the insurance mechanisms

After all the steps outlined above have been properly taken, all risk must be shifted to the insurance industry. Since not all risks are insurable, the community needs to research their insurability and their settlements. Hazards may not present such a disastrous consequence themselves, but it is a peril to which only a given sector of the population is exposed to and there is believed to be no feasible way to spread the risk over a large enough sector of the population. The flood hazard, the rising or overflow of bodies of water, was long considered to be virtually uninsurable because only those who are faced with such bodies of water would be interested in obtaining insurance (*ibid*).

2.12 RECOMMENDED POLICIES TO IMPROVE THE RELATIONSHIP BETWEEN THE INSURANCE INDUSTRY AND FLOODPLAIN MANAGEMENT AUTHORITIES

National Water Act (36 of 1998) addresses flood risks and its impacts on insurance companies in the GLM. This sections aims at looking at international policies that might assist in improving the relationship between the insurance industry and floodplain management authorities. International legislative and administrative policies frequently cite two approaches for adjusting to the modern flood risks methodologies (Hung-chih hung, 2009). The structural approach is anticipated to mean adjustments that modify the behaviour of floodwaters through the use of procedures such as dams, levees, and channel alterations. The non-structural approach is intended to include all other adjustments (e.g. flood insurance) to the way society acts when occupying a floodplain. Both structural and non-structural tools are used for achieving desired future floodplain conditions. FEMA (2002) states that the international arena has three basic strategies that may be applied individually, or in combination, to better manage floods:

- Modifying the susceptibility to flood damage and disruption;
- Reducing the adverse impact of floods on the individual and the community; and
- Modifying the floods themselves.

In the GLM, guidelines and extensive workshops must be presented to floodplain residents in order to make them more aware non structural and structural approach. The structural approach will assist, in the GLM, as they currently have more rivers and catchment areas. The GLM should discourage the development of floodplains and invest in roads and storm water drainage that can handle huge amounts of water, build flood controlling dams.

2.12.1 Floodplain controls

Floodplain controls are comprehensive tools for modifying future susceptibility to damage or loss (The United States Department of Homeland Security, 2007). By providing direction to growth and change, regulations are particularly well-suited to preventing unwise floodplain occupancy by people. Land use controls require that individuals recognize the general welfare when making decisions. Legal treatment of floodplain regulations and their adoption needs to be addressed by the local Council, through municipal by-laws (FEMA, 2002). In the GLM, the legislation is there, but the enforcement of the policies seems to be the difficult part. Hence the GLM residents settle on floodplains and expect insurance to pay-out the damages.

The regulatory aspects of floodplain management programmes are sensitive to political pressures, but they can be effective when equitably reinforced in all government spheres (*ibid*). Several types of "police power" regulations are in use in some municipalities, and nearly all localities, to regulate land use in flood hazard areas. The principal local control of flood hazard areas is through zoning, subdivision regulations, building and housing codes, and sanitary codes with specific flood hazard provisions (Crowell, Hirsh & Hayes, 2007).

The United States Department of Homeland Security (2007) states that the administration of riverine floodplain zoning ordinances is simplified by the designation of floodplain encroachment limits (see Figure 2). Floodway limits are designated, as part of the planning process, so that any development that is permitted in the remainder of the floodplain will not result in a flood stage increase, over a prescribed amount, of a specified frequency flood at any location along the stream. In the GLM residence occupy any piece of land because it's suspected that there are floodplain regulations, therefore making the residence more vulnerable to flood risks. The introduction of floodplains regulations might decrease the flood damage to properties in the GLM

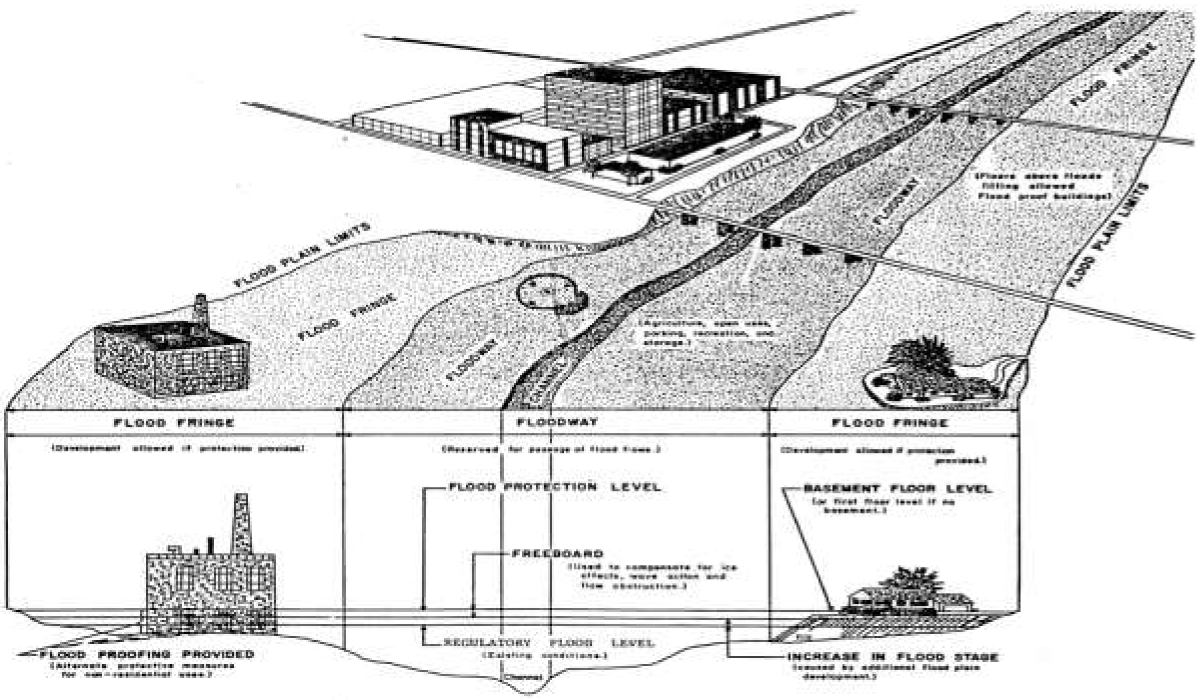

Figure 2: Illustration of the floodplain control terms (FEMA, 2002)

Measures to reduce the flood risk to a community can seek to reduce the physical hazard, reduce the exposure to the hazard, or reduce the vulnerability to loss and increase the ability to recover (FEMA, 2002). Similarly, Wallingford (2002) found that flood defence is traditionally concerned with reducing the physical hazard, although current flood risk management practices do try to consider, and include, all three measures in Table 5.The reduction of flood risks in the GLM may result into properties being less vulnerable to floods and insurance companies playing a less role in flood recovery.

Table 5: Example of measures to reduce flood risks.

Measure to reduce the flood risk	**Example measures**
Reduce the physical hazard	Flood embankments/ Sea defence River channelising Washland storage Reservoir impoundment Catchments management
Reduce exposure to the hazard	Land-use planning Property-scale flood proofing
Reduce vulnerability to the hazard	Warning and preparedness Insurance

Source: Adapted from (FEMA, 2002).

Table 5 provides the ways in which flood risk can be reduced anywhere in the world. The GLM can reduce their flood risks by river channelling the flood water into the sea, and building more reservoirs. It can further more help by enforcing proper land use management. Flood risk reduction initiatives must be implemented to reduce the flood risk impact in the GLM.

2.12.2 Development and redevelopment policies

Public actions such as employing police power, municipal by-laws, and permanent relocation can modify susceptibility to flood damage. The design and location of services and utilities reduces flood loss by guiding private and public developments to low risk areas. The GLM can exercise discretion in extending roads, sewers or water mains (or access to them) in flood hazard areas. Libraries, schools, post offices, and government critical facilities must be located away from flood prone areas (FEMA, 2002). Redevelopment may offer measures for regulating floodplain areas, by improving both economic efficiency and the natural environment.

2.12.3 Flood proofing

Flood proofing can provide for development in lower risk floodplain areas by keeping damage within acceptable limits. It can consist of modifications of structures, their sites, and the building contents, to keep water out or reduce the effects of water entry. A primary reason for flood proofing structures is to reduce property loss. The application of economic criteria is more likely to justify flood proofing for commercial structures than for residential structures (*ibid*). In the GLM, there are structures that have been flood proofed but the standards of flood proofing building are not regulated by local government.

2.12.4 Modify flooding

According to the United States Department of Homeland Security (2007), the traditional strategy for modifying floods relies upon the construction of dams, dikes, levees, floodwalls, channel alterations, high-flow diversions and spillways, and land treatment measures. These tools permit changes in the volume of runoff; the peak stage of the flood; the time of rise and duration; the extent of the area flooded; the velocity and depth of floodwaters; and consequently in the amount of debris, sediment, and pollutants that floods carry. While the effectiveness of these tools in protecting property and saving lives has been demonstrated repeatedly, sole reliance upon a flood modification strategy is neither practical nor desirable.

The GLM must concentrate on mechanisms for widespread risk sharing, while the SAIA should provide persuasive strength and beneficial emphasis to local floodplain management. The insurance coverage must be made available at subsidized rates to property owners whose location decisions, and building construction, are completed before identification of the specific nature and extent of their flood hazard. Coverage must also be made available at actuarial rates to property owners of new buildings. Insurance may not be sold in areas designated under the 1 in 50 year return period (FEMA, 2002).

FEMA has the most advanced flood insurance policy guidelines that the GLM can implement for regulating and improving the relationship between insurance and flood management. Flood insurance information must be provided to potential buyers of flood prone properties, regarding the economic cost of decisions about location, and thus and should serve to discourage unwise construction in hazardous floodplain areas. Government does not have to regulate short-term insurance companies. The insurance must play a significant role in flood risk reduction programmes for a reduction in property damage.

2.13 CONCLUSION

This chapter discussed literature on the international and local polices that regulate flood insurance industries. It also recommended international policies and practises that can be recommended to the GLM to reduce the impact of floods on insurance companies. The GLM does not yet have programmes that will compensate for flood damage. Therefore, the GLM relies mainly on the private sector to pay out flood damages. This chapter also provided the economical flood damage statistics of floods, globally and nationally. Lastly, it provided theoretical mechanisms for flood insurance companies on how to manage flood risks.

CHAPTER THREE

3. RESEARCH DESIGN

3.1 INTRODUCTION

This chapter describes the methodology and research design for this study.

According to Polit and Hungler (1983), a research design is described as the organisation of a scientific study. McMillan and Schumacher (1993) state that research can be classified into qualitative and quantitative research. This chapter serves as the framework that guides the research design. In this context, the research design is described as the following:

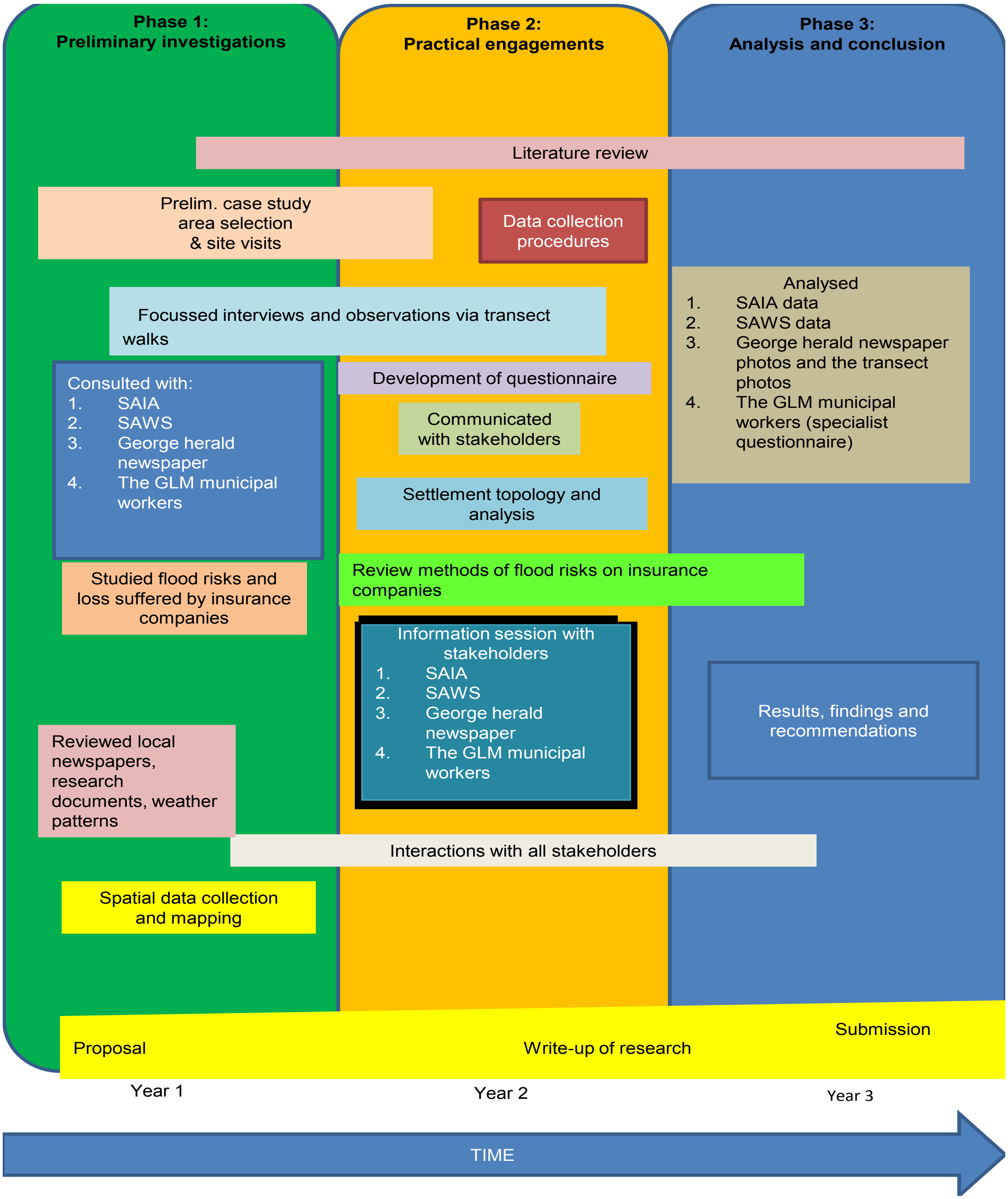

Figure 3: Research design of the study (Storie, 2011).

The research design was divided into three years as showed in Figure 3. The first year it was mainly preliminary investigations, while the second year was focused on practical engagements, and the last year was centred on analysing and summarising the study. The three years assisted in identifying the properties that are flooded in the GLM. It also helped in mapping the areas affected, and determining which social income networks groups insure their properties with the insurance companies.

3.2 THE RESEARCH METHODOLOGY

Barbie and Mouton (2001) describe quantitative research designs as either descriptive (establishes only associations between variables) or experimental (try to measure variables that might explain the mechanism of the treatment). Quantitative studies are usually conducted under controlled settings and involve the collection of data from small to larger samples. Normally, the data is subjected to statistical analysis. Various methods were used to answer the aim of the study.

This study follows the same approach as described above by analysing statistical data from the SAIA and South African Weather Services (SAWS),observation and transect walk (photo illustrating flood impacts) analysis of flood damaged properties and lastly by a questionnaire which was designed for the specialists. The above mentioned data analysis are characteristics of quantitative methodology.

3.3 THE STUDY SETTING

3.3.1 Location and socio-economic profile of the GLM

The GLM includes the following cities and towns: Blanco; Pacaltsdorp; George; Bo-Dorp; Heather Park; Wilderness/Hoekwil; Lavalia; George Middle-Dorp; Lawaaikamp; Herorldsbaai; Conville; Pardene/Ballowtsview; Thembalethu; Sea View / Nu; Dawn; Rosemore; Ballotsview; Loerie Park; and Denver Park. The physical location of the GLM is shown in Annexure A. These areas are the ones that have been most affected by the floods in the GLM, and they are listed on documents of the flood damage claims and payouts in the SAIA.

According to Land Religion and Development Research (2006) the GLM area has a Mediterranean climate, with warm summers and mild to chilly winters. In the GLM Most of the rain falls in the winter and spring months, brought by the humid onshore from the Indian Ocean. The GLM features an attractive coastline; moderate climate; lush, alien vegetation; water resources; and beautiful scenery, contributing to the prospects of economic growth in the area but also leading to its relatively high population growth and competition for scarce resources (*ibid*).

Table 6 indicates that the current population of the GLM. The average population growth rate of the Western Cape is 2.7 percent (George Local Municipality Integrated Development Plan, 2005). The population profile gave an idea of how many people gets affected by floods. The study though has focused of those individuals that can afford flood insurance.

3.3.2 Demographics

According to Land Religion and Development Research (2006), the population for the GLM is distributed as follows:

Table 6: Total population (all individuals) for the GLM residents.

Wards	Black %	Coloured %	Asian %	White%	Other%	Total%	Number
10404001	4.03	75.66	0.09	19.95	0.27	100.00	1 093
10404002	1.75	4.96	0.00	92.42	0.87	100.00	686
10404003	1.76	1.90	1.32	94.00	1.02	100.00	683
10404004	14.38	69.54	0.00	15.12	0.96	100.00	939
10404005	1.22	95.96	0.75	1.13	0.94	100.00	1 065
10404006	6.16	93.66	0.00	0.18	0.00	100.00	1 136
10404007	16.93	82.91	0.00	0.08	0.08	100.00	1 264
10404008	3.34	94.82	0.00	0.00	1.84	100.00	1 139
10404009	96.16	3.84	0.00	0.00	0.00	100.00	886
104040010	98.32	1.12	0.00	0.00	0.56	100.00	892
104040011	98.24	1.39	0.09	0.00	0.28	100.00	1 082
104040012	48.17	50.33	0.10	0.10	1.30	100.00	1 995
104040013	95.27	4.33	0.20	0.00	0.20	100.00	994
104040014	1.85	97.46	0.00	0.10	0.59	100.00	1 025
104040015	0.36	96.88	0.00	2.76	0.00	100.00	834
104040016	4.67	85.92	0.00	8.93	0.48	100.00	1 456
104040017	3.72	95.76	0.00	0.17	0.35	100.00	1 156
104040018	1.91	3.27	0.00	94.68	0.14	100.00	733
104040019	5.01	22.80	0.22	70.75	1.22	100.00	899
104040020	16.38	83.05	0.29	0.10	0.19	100.00	1 050
Total	**24.90**	**54.96**	**0.19**	**19.53**	**0.41**	**100.00**	**10 950**

Source: adapted from Unit for Religion and Development Research (2006)

The Table 6 indicates the group breakdown; Blacks sit at 24.90 percent, Coloureds 54. 96 percent, Asians 0.19, Whites 19.53 and others occupy 0.41 percent. The population is dived into ethnic groups. The Asians, Whites and Colored are the ones that submit most property damage claims in the GLM. The three mentioned populations groups are the ones most vulnerable to floods due to them settling on floodplains. The population growth has increased since 2001. According to Bekker (2004), the population of the GLM will be 239 089 by 2010 (George Local Municipality IDP, 2004).

3.3.3 Employment

According to the Unit for Religion and Development Research (2006), the employment rate for GLM is distributed in Table 7 as follows:

Table 7: Employment status (individuals older than 15) for the GLM.

Wards	**Paid Employee %**	**Self-Employed %**	**Employer %**	**Unemployed %**	**N/A %**	**Total %**	**No**
10404001	43.86	1.55	0.13	45.15	9.31	100.00	773
10404002	31.03	9.66	0.17	55.17	3.97	100.00	580
10404003	35.03	11.43	0.54	47.01	5.99	100.00	551
10404004	39.24	3.49	1.31	51.16	4.80	100.00	688
10404005	52.49	1.66	0.00	43.17	2.68	100.00	783
10404006	45.80	1.63	0.12	48.02	4.43	100.00	858
10404007	41.99	1.33	0.24	50.61	5.83	100.00	824
10404008	37.48	0.86	0.00	52.90	8.75	100.00	811
10404009	34.35	1.36	0.00	58.16	6.12	100.00	588
104040010	37.73	1.84	0.00	56.09	4.34	100.00	599
104040011	36.38	2.01	0.00	56.78	4.83	100.00	745
104040012	43.69	2.21	0.44	47.53	6.13	100.00	1 355
104040013	33.70	1.72	0.00	57.21	7.37	100.00	638
104040014	36.07	1.39	0.00	58.20	4.33	100.00	646
104040015	46.69	1.74	0.00	47.95	3.63	100.00	634
104040016	48.84	5.23	0.29	41.28	4.36	100.00	1 032
104040017	42.37	0.00	0.00	55.07	2.56	100.00	819
104040018	25.21	13.28	1.68	57.14	2.69	100.00	595
104040019	39.05	9.22	1.15	48.70	1.87	100.00	694
104040020	35.73	0.95	0.00	60.33	2.99	100.00	736
Total	39.21	4.07	0.41	51.64	4.67	100.00	7 816

Source: Adapted from (URDR, 2006).

The high population growth inevitably leads to increased unemployment, which is estimated to be 21percent of the labour force of an approximated labour force of 66 500 (roughly 41 percent of the population). A recent forecast revealed that 30 percent of the households live below the poverty line (George Local Municipality Economic Analysis, 2005).Property flood damage claims are normally submitted by those employed, because they can afford property insurance which covers for the flood insurance.

3.3.4 Property

According to the Unit for Religion and Development Research (2006), the housing in the GLM is structured in the following manner:

Table 8: Types of houses in the GLM.

Ward number	Formal house%	Informal dwelling in backyard %	Informal dwelling not in backyard %	N/A %	Total %	No
10404001	83.23	3.87	12.90	0.00	100.00	310
10404002	98.80	0.80	0.40	0.00	100.00	251
10404003	99.63	0.37	0.00	0.00	100.00	270
10404004	68.46	1.68	29.19	0.67	100.00	298
10404005	87.31	4.48	7.84	0.37	100.00	268
10404006	88.81	9.75	1.44	0.00	100.00	277
10404007	87.41	8.15	4.07	0.37	100.00	270
10404008	82.07	1.99	15.94	0.00	100.00	251
10404009	60.00	1.30	38.26	0.43	100.00	230
104040010	65.78	4.94	28.52	0.76	100.00	263
104040011	54.64	1.43	43.21	0.71	100.00	280
104040012	85.22	1.54	12.86	0.38	100.00	521
104040013	59.59	0.00	38.78	1.63	100.00	245
104040014	97.63	0.40	1.98	0.00	100.00	253
104040015	83.48	4.78	11.74	0.00	100.00	230
104040016	80.16	2.35	16.45	1.04	100.00	383
104040017	87.40	6.11	3.82	2.67	100.00	262
104040018	98.89	0.00	0.37	0.74	100.00	271
104040019	97.67	1.66	0.00	0.66	100.00	301
104040020	84.46	2.39	12.75	0.40	100.00	251
Total	**82.98**	**1.96**	**14.50**	**0.56**	**100.00**	**3 014**

Source: Adapted from (URDR, 2006).

According to the URDR (2006), 82 percent of houses in the GLM are formal houses, 15 percent are informal dwellings not in the backyard, 2 percent are informal dwellings in the backyard and the remaining 1 percent are for none applicable houses (refer to Table 8). This study has focused more on the formal properties, which can have the funds for flood insurance. The formal houses flood claims has been used to determine the loss that insurance companies face after floods occurrences.

3.3.5 Justification for selection

Probabilities of flood occurrence are rated high due to its location near the Indian Ocean, where severe weather changes and the topography of rivers and the land increase the potential for high rainfall. In addition to this, the development of properties on floodplains at times makes the insurance companies to loss profits when flood disaster occurs (URDR, 2006). In 2005/07, the municipality experienced heavy floods (Bekker, 2004).The municipality attempts annually to plan, mitigate and prevent the impact of floods unfortunately, the GLM always gets worse consequence that the previous years (Knoetze, 2007). This study will assist in ways to reduce flood impact on the municipality.

3.4 DATA COLLECTION PROCEDURES

3.4.1 The population and sample

Polit and Hungler (1983) define a sample as part of the population selected to participate in an event, while a population can be defined as the entire group that meets the specific criteria of a specific study. The study was constituted with a sample of specialists to address the objectives of the study. Ndlovu (2007) stated that specialists have more accurate views on flood risk than lay people. Therefore, the researcher identified specialists deemed critical in flood insurance identify the impacts that floods has on the social, economic, environmental and physical infrastructure. All these specialists currently work or have recently worked in the area and therefore have good knowledge on flood risks and flood insurance companies. The chosen population group of specialist was selected in order to provide comprehensive information regarding flood risks and their impact on insurance companies (Thorne, Evans, Edmund & Penning-Rowsell, 2007). Twenty various specialists were chosen to participate in the study.

3.4.2 Sampling and Sampling procedures

According to Huysamen (2001), there are different forms of sampling that can be applied in quantitative studies. Sampling is a process of selecting a portion of the population to represent the entire population. Purposive random sampling was used to select the population group. According to Mouton (2001), purposeful sampling means selecting information-rich cases for a study, when one wants to understand something without needing or desiring to generalize in all cases.

According to Leedy and Ormrod (2001), purposeful samples are usually small compared to the simple random sampling methods. Mothata (2000) emphasizes that purposeful samples are small because a few cases are studied in-depth and may yield much insight on the topic. In this study, small purposeful samples of key municipal respondents were therefore chosen to yield insightful information on how the municipality identifies flood risks and their impact on insurance. The researcher identified specialists working with floods and insurance. All the specialists directly or indirectly worked in the area. The specialists group thus consist of the following key-respondents:

- Hydrologists from the Department of Water Affairs and Forestry.
- Representatives from the South Africa Insurance Association.
- Infrastructure and town engineers from the George Local Municipality.
- Meteorologists from the South African Weather Services.

A summary of specialist questionnaire feedback is in Table 15 on page 151.

3.5 DATA COLLECTION

According to (Leedy & Ormrod (2001), data collection is an activity in which the researcher observes people and events, examines documents, and interviews people. In this research, the instruments used were: review of documents, questionnaire for municipal workers(Annexure B), and observations of damaged properties were captured by the local newspaper.

3.5.1 Review of documents

Quantitative research includes examining and comparing literature. Mothata (2000) describes document analysis as a common term for different types of contextual analysis where approaches emphasize either qualitative and/or quantitative descriptions and analysis of documents of various types. Document analysis, therefore, means the procedure for systematically analyzing written material.

Documents to be reviewed can either be personal or official. According to McMillan and Schumacher (1993), a personal document includes anecdotal records, such as a log; journal; and notes on lessons plans, or lessons learned. The GLM Herald newspaper provided flood impact pictures to show the damage caused by floods.

3.5.2 Transect walks

Transect walks are another medium (spatial data) used to collect information (Jones, 1996). They are important in data gathering for land use, socio-economic activities, rainfall patterns, and flood risk maps (among others). The transect walk was done of the following areas: Blanco; Pacaltsdorp; George; Bo-Dorp; Heather Park; Wilderness/Hoekwil; Lavalia; George Middle-Dorp; Lawaaikamp; Herorldsbaai; Conville; Pardene/Ballowtsview; Thembalethu; Sea View / Nu; Dawn; Rosemore; Ballotsview; Loerie Park; and Denver Park.

3.6 PROCEDURES FOR DATA ANALYSIS

According to Hittleman and Simon (1997), data analysis, means working with data, organizing it, breaking it into manageable segments, synthesizing it, searching for patterns, discovering what is important and what is to be learned and deciding where to tell more. A quantitative methodology was used to analyse the SAWS data in graphs and tables; the SAIA data by GIS, graphs and table; transect walk by photo analysis; and the questionnaire for specialist by graphs and tables.

3.7 CONCLUSION

This chapter dealt with the design and methodology of the research. The chapter presented study settings, data collection procedures, the research instrument and data collection, and data analysis of the study. A purposive sample of specialists, the SAWS, SAIA and the transect walk observations has enabled the researcher to obtain information on flood risks in the GLM.

CHAPTER FOUR

4. OUTLINE, INTERPRETATION AND DISCUSSION OF FINDINGS

4.1 INTRODUCTION

In this chapter, the focus is on the presentation, interpretation and analysis of the data gathered. Data discussion and interpretation involves discovering and maintaining patterns in the data, looking for general orientation in the data, and trying to sort out what the data is all about (Hitchcock & Hughes, 1994). During this analysis, an attempt will be made to explain the data, relating it to the GLM flood risks insurance, organizing it into statistical graphs, tables and, categorising it into manageable units (sub-tittles and paragraphs), synthesizing it (producing valuable information), identifying patterns (finding the link between the rainfall data and the SAWS data) and deciding what is important (sectors mostly affected by floods in the GLM). The data will be analysed in sections as per data collected from:

- SAWS;
- The observation done through the transect walk;
- SAIA; and
- Questionnaire for the specialists.

4.2 ANALYSIS AND INTERPRETATION OF DATA COLLECTED FROM THE SOUTH AFRICAN WEATHER SERVICES

This section aims to identify rainfall patterns in the GLM. It analysed the SAWS rainfall data. The study was aimed at finding the relationship between the high rainfall peaks and the insurance claims from 2005 to 2007. It is expected that the findings will help the insurance industry, SAWS, and the community in terms of infrastructure planning, agriculture practices and land management issues.

4.2.1 Background on rainfall data for the George Local Municipality

The SAWS receives rainfall data from 94 rainfall districts in South Africa, as indicated in Figure 4. This data is stored in the SAWS Structured Query Language (SQL) database and made available to the public on request. For this study, District 11 is applicable, and it refers to the weather station that covers the whole of the GLM. This study analysed and interpreted the rainfall data to show trends from 1921 to 2007. The aim was to establish rainfall trends, and show how the rainfall can affect and damage physical infrastructure. After floods have destroyed the physical infrastructure, property owners then, submit claims to the insurance companies. However, Du Plessis and Viljoen (1999) stated that, if a community does not have proper drainage systems, the floods will likely damage more physical infrastructure because there are no channels to transport and direct the water to the dams and catchment areas.

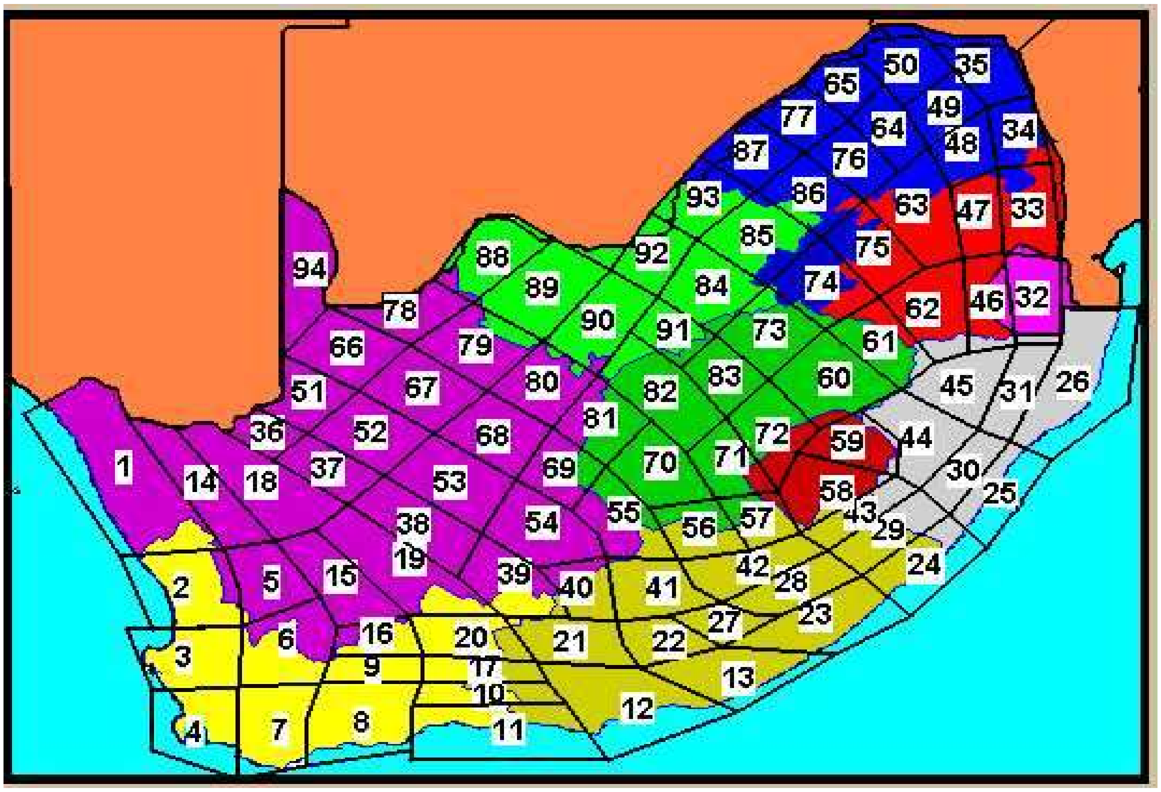

Figure 4: Rainfall districts in South Africa (McBride, 2001).

4.2.2 Monthly rainfall analysis

Changes in rainfall characteristics directly impact hydrology, water resources, and land-use management (United Nations for Development Programme, 1992).The GLM is separated from the Little Karoo by the Outeniqua Mountains, which contribute to the cooler and wetter conditions enjoyed along the South Cape Coast. As alluded to earlier, the GLM also lies between two climate zones, the Cape Mediterranean with its winter rainfall and the temperate spring rainfall area around Port Elizabeth. The area receives an average of 189.27 mm of rainfall annually. This is due to the southerly movement of cold fronts which brings winter rains to the south and south-western Cape (Anderson &

Woodrow, 1998). The GLM receives most rainfall in the winter and spring season, hence most property damaged was also recorded during winter and spring months.

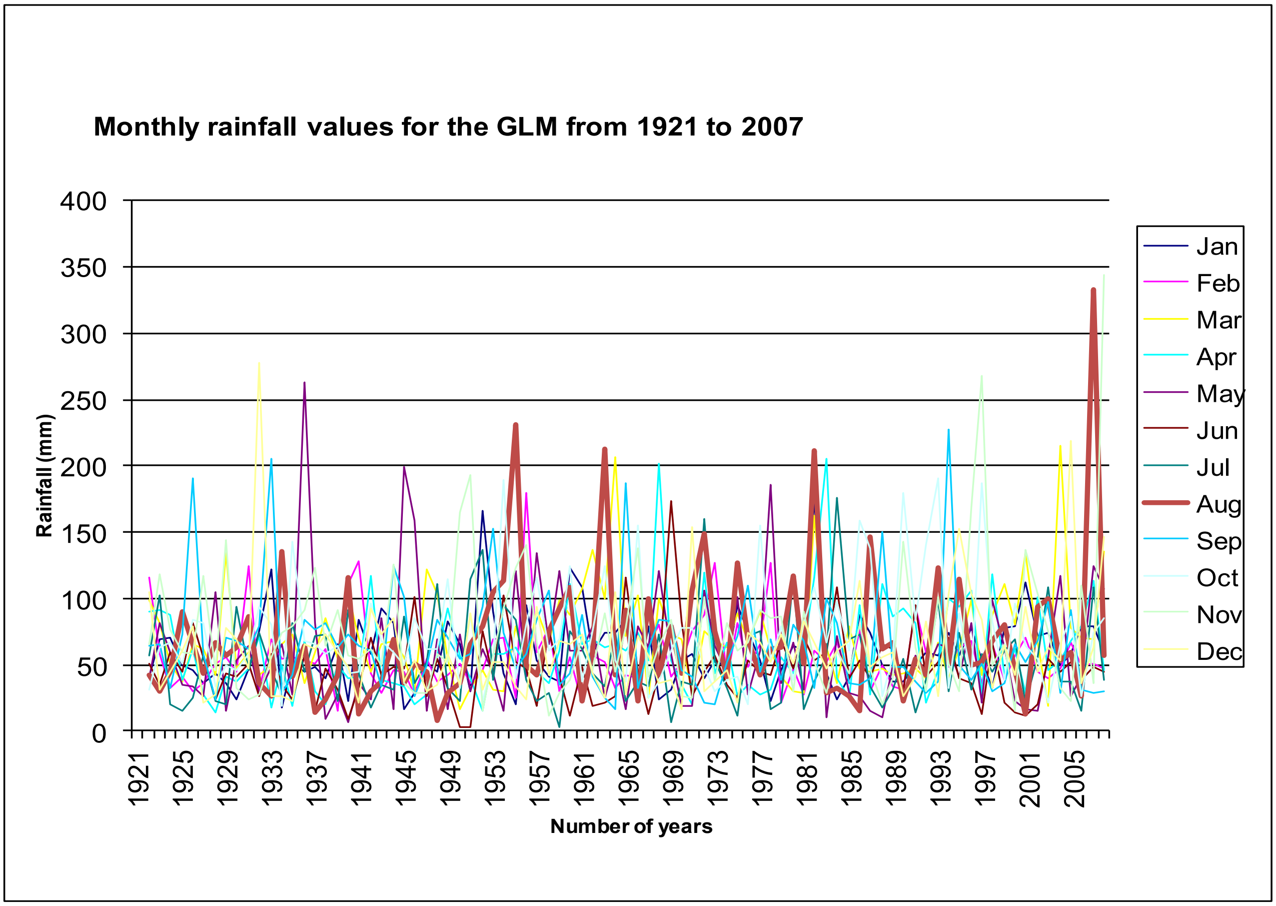

Figure 5: Monthly rainfall values for the GLM from 1921 to 2007

Figure 5 shows the average, monthly maximum and minimum occurrence of rainfall for a 86 year period between 1921 and 2007 for the GLM. In the GLM, the highest recorded monthly rainfall of 344mm (millimetres) which occurred in November 2007, while the lowest monthly rainfall value was 10, 8mm in May 1982. This study found that in 2007, there was an estimated loss of just over R3, 154,000 (which amounts approximately UK £26.3 million pounds) due to flood damage. This means that during the winter and spring months insurance companies experience most flood damage claims – much more than in the summer and autumn seasons. It is suspected that during summer and autumn the insurance companies make more profit since there are less flood damaged claims submitted.

Table 9 shows the calculated rainfall distribution for the GLM. It shows that most rainfall is experienced in winter, with 47 percent, and then followed by spring, with a percent of 45. Summer and autumn experience the least rainfall distribution, with both of the seasons having 4 percent of rainfall. Therefore, the GLM receives more rainfall in spring than in any other seasons. This means that yes, there is a link between the rainfall peaks and the insurance companies' damage claims. The more the flood experienced in the GLM, the more properties are damaged, especially during the winter and spring seasons.

Table 9: Seasonal rainfall distribution for the GLM from 1921 to 2007.

Season	Amount of Rainfall (mm)	Number	Percentage
Winter	18231.4	1	47%
Spring	17253.2	2	45%
Autumn	1632	3	4%
Summer	1400.5	4	4%

Source: Adapted from SAWS (2011).

Table 9 illustrates the maximum rainfall values which occur mostly during peak rainfall periods (winter and spring seasons) in the years between 1921 and 2007. This means that, insurance companies have suffered a loss during the peak rainy seasons. Although the data received (Figure 5) was on a monthly basis, it is possible that there was missing data for some days on particular months, due to damage or fault in a rain gauge during a period equipment of stations. When monthly raw rainfall data is analysed, consideration for the missing points must be taken into account, in order to determine the retention or exclusion of a month (Watson & Lilly, 1997). When reviewing the monthly rainfall totals, it is important to note that when the most rainfall is experienced, the probabilities of floods increase proportionally in the GLM, and cause most property damage during these periods/seasons. This has a negative impact on insurance companies in those particular times of the year, which means that they have to ‘make up’ the losses during other months after floods. This requires the GLM residents to have functional flood plans; else floods will always be a setback on the insurance companies – sometimes to the extent that they cannot recover effectively from the financial loss.

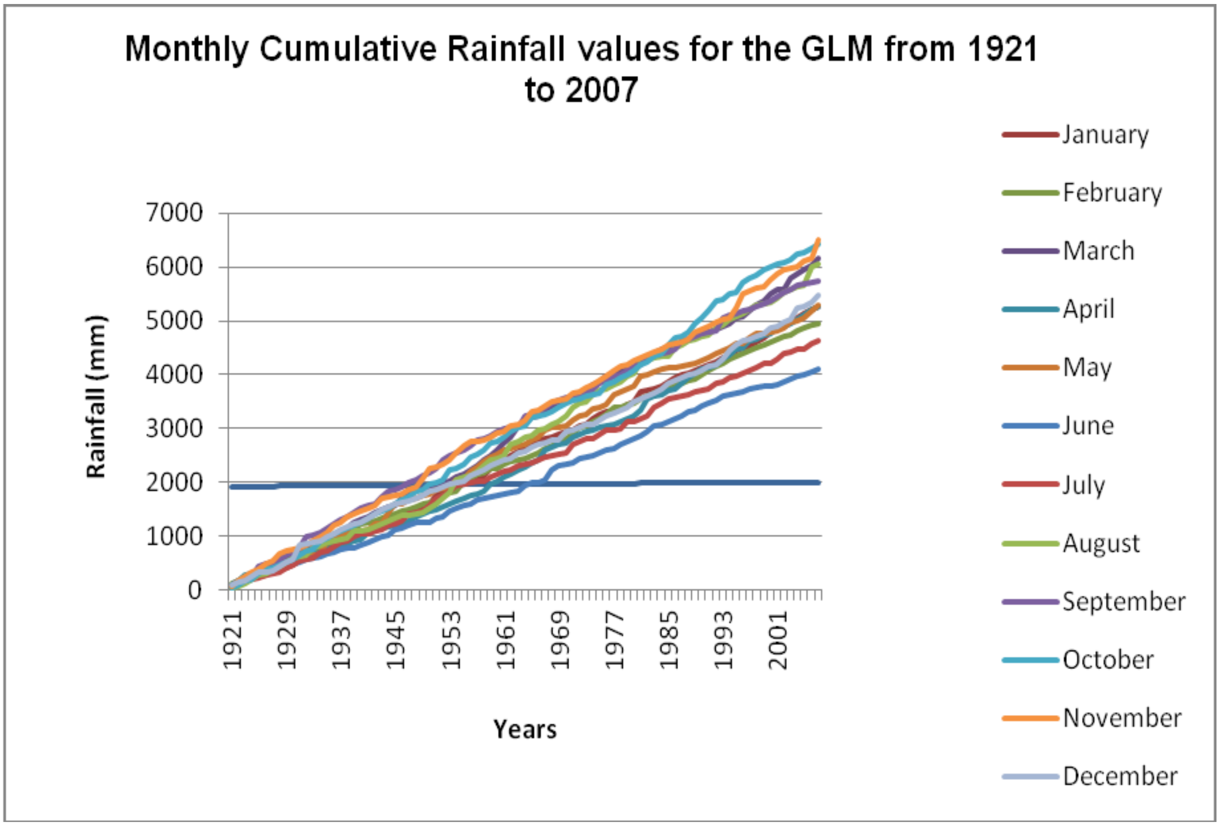

Figure 6: Monthly cumulative rainfall values for the GLM over a period of 86 years

Figure 6 shows that there is an increase in the rainfall from the 1921 to 2007. To investigate how rainfall may have changed, a cumulative rainfall distribution graph was plotted in Figure 6. The rain has increased due to channel width and depth, stream temperature, stream flow, and substrate particle diameters (Gordon, McMahon, Finlayson, Gippel & Nathan, 2004). There is an even increase in the value of rainfall patterns from 1921 to 2007. However, the high rainfall values are observed within the last 30 years. During this last 30 years, most people have chosen to settle on the floodplain, and rather than avoid risk, protect their properties through financial insurance.

According to (*ibid*), an increase in temperature may lead to the most frequent rainfall at times. However, monthly rainfall records internationally are analysed to determine when the rainy season commences and when it ends (*ibid*). The rainy season, on average, starts in August and ends towards April. The flood loss to property in the GLM falls within winter and spring (Mooiman, 2007). According to Smith and Greenaway (1993), there is a link between high rainfall and property damage, because extreme weather patterns processes may affect physical structures in negative way. Economic and social factors have contributed to the increasing likelihood of financial losses. The development of floodplains for business purposes and people staying in floods zones due to employment opportunities does play a role in increasing flood risk vulnerability. People increasingly develop their properties on flood plains and in areas that are prone to other types of flooding, in order to satisfy either their demand for aesthetics (i.e. living alongside a water body) or due to pressure of densification in urban areas. A lack of integrated floodplain management plans and insurance policy may result into one party gaining and the other party loosing, since it is suspected that if insurance companies lose their profits due to natural disaster, they may increase premiums to recover funds lost. Insurance companies may suffer loss since in the GLM there may be flood plain delineations but they are not adhered to be developers.

4.2.3 Annual total rainfall for GLM from 1921 to 2007

Annual rainfall analysis for a district is important for planning for agriculture, infrastructure and floods (Hulme, Doherty, Ngara, New & Lister, 2001). Therefore, it is necessary to analyse data that covers long periods and which is sourced from reliable weather stations (Van Wageningen & Du Plessis, 2006). Mason, Waylen, Mimmack, Rajaratnam & Harrison (1999) found evidence of significant increases in the annual extremes between the periods of 1931 to 1961 and 1961 to 1990 in the Eastern and Western Cape. Grisman, Knight, Eaterling, Karl, Hegerl & Razuvaer (2005) found no significant change in the winter precipitation totals for the GLM region from 1906 to 1997, but found a significant increase in the annual frequency of heavy precipitation during the same time. This means that the GLM receives lots of rainfall although the years, but predominantly during winter and spring making the area more vulnerable to floods since some of the residence stay in floodplains. The GLM floodplains are very fertile lands for farming (*ibid*). The flooding keeps renewing the lands' ability to grow alien vegetation in and around floodplains due to the abundance of growth floodplains frequently flood unless the source (usually a river) is levied to keep the water out of some cities in the GLM.

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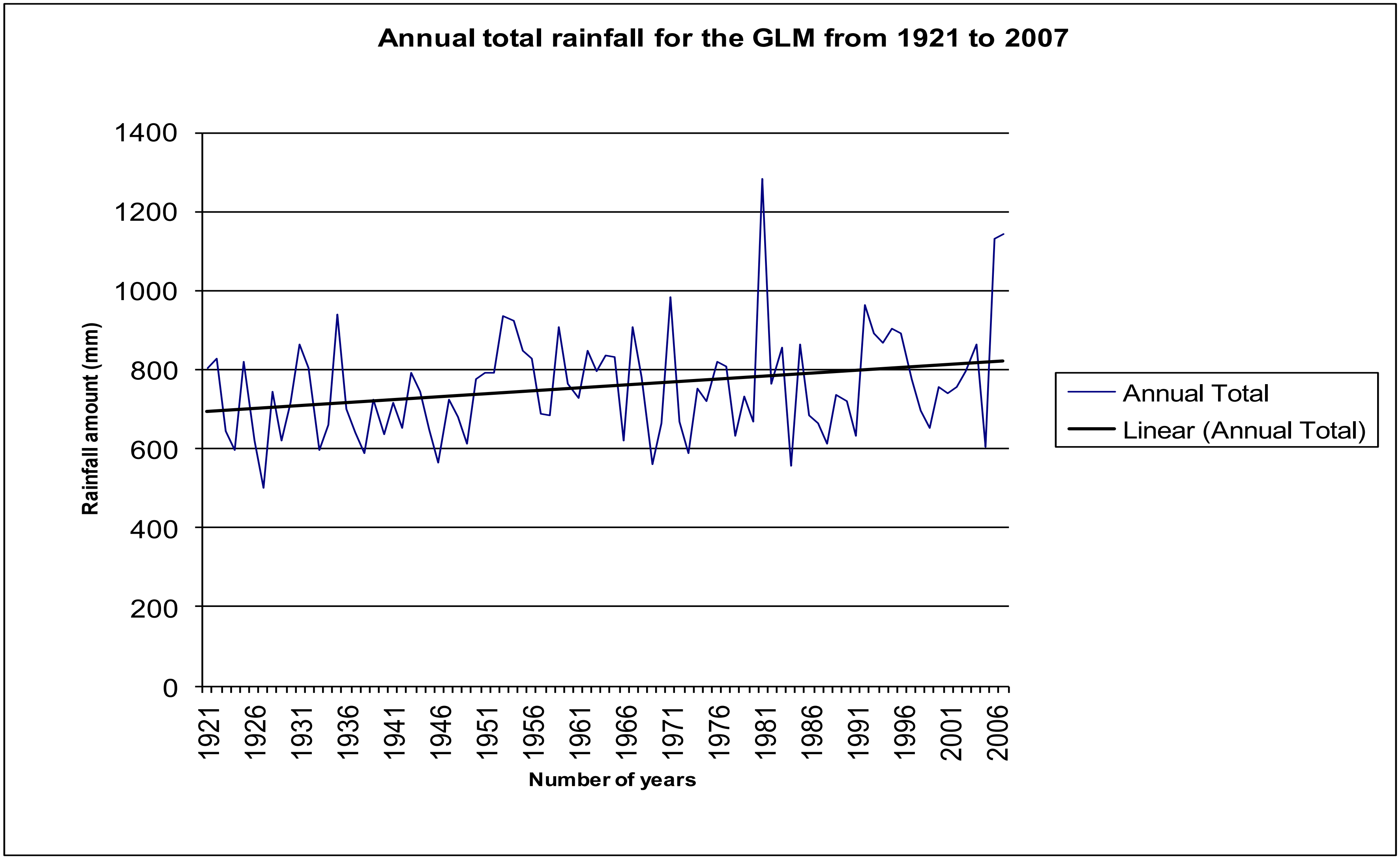


Figure 7: Annual rainfall totals for the GLM over a period of 86 years.

During floods, some infrastructure cannot withstand heavy rain falls. Continuous, heavy rainfall can damage property, leading to a significant increase in insurance claims (Gill & Kruger, 2004). This might make the insurance companies to increase premiums to cover for their potential losses.

Figure 6 and 7 shows that there was a seady increase in annual rainfall from 1921 to 2007. High rainfall does not necessarily result in floods. It depends on the ground water absorption, the dryness of the area, and the rate at which the area filters water during a specific period (Gwata, 2007). In the GLM it's about rainfall intensity and severity that damage properties. This leads to floods having a negative impact on the social, economic, environmental and physical infrastructures.

Table 10 Annual rainfall values of GLM from 1921 to 2007.

Year	Annual Total	Year	Annual Total	Year	Annual Total	Year	Annual Total
1921	803.8	1941	717.2	1968	782	1988	612.6
1922	829	1942	651.3	1969	562.6	1989	735.9
1923	645.6	1943	793.6	1970	666.1	1990	718.7
1924	596.5	1944	746.1	1971	982.1	1991	630.8
1925	821.8	1945	647.6	1972	666.5	1992	961.8
1926	622.2	1946	564.9	1973	590.2	1993	890.3
1927	500.2	1947	722.9	1974	751.5	1994	866.6
1928	745.9	1948	679.9	1975	719.6	1995	901.8
1929	620.4	1949	611	1976	819	1996	890.8
1930	718	1950	776.5	1977	808.9	1997	776.3
1931	864.5	1951	790.5	1978	631.3	1998	698.3
1932	804.7	1952	793	1979	730.8	1999	650.9
1933	597	1953	936.8	1980	668.5	2000	754.7
1934	660.4	1954	922.7	1981	1281.5	2001	739.6
1935	940.6	1955	848.7	1982	763.8	2002	754.5
1936	698.4	1956	827.2	1983	857	2003	797.6
1937	638.9	1957	688.4	1984	557.7	2004	865.4
1938	587.1	1958	685.3	1985	862.7	2005	604
1939	723	1959	906.8	1986	684.2	2006	1130
1940	634.7	1960	764.1	1987	666.1	2007	1142.2

Source: Adapted from SAWS (2011).

From Table 10, the following can be deduced: the lowest rainfall was observed in 1927 with 500.2mm; the highest rainfall was observed in 1981 with a 1281.5mm. The rainfall average per year was between 600mm and800mm. The detailed analysis of all the rainfall events in the GLM yielded very clear trends (increasing) for the period analysed.

It was clear that despite the fairly constant total yearly precipitation, if it is observed in relation to the number of rainfall events during which the rain occurs the number of rainfall events seems to be increasing significantly. According to Van Wageningen & Du Plessis (2006), the logical deduction is that rainfall intensities must have increased in this analysis period, to sustain the total yearly precipitation.

In 2006/07 the GLM received an average of 1,136mm, which means that the area received more rain and soaking the land, increasing fertility of the soil, and thus increasing the agricultural output (better plant growth). This was a positive impact on the commercial agricultural farmers since they yielded more crop production, than previous years. On the other hand live stock farmers lost their livestock due to the floods.

4.2.4 Flood frequency

Most of the GLM resident tends to have a greater concern for the potential of increased floods (Carstens, 2008). For many years successive generations of residents in the GLM have been exposed to floods and severe rainfall. For many it forms part of a lifestyle in an environment, which is, as a rule, amenable to human settlement. Meaning that, there is a prolific record of floods in the GLM. According to Van Wageningen & Du Plessis (2006), there seems to be consensus amongst locals that ‘unusual’ weather conditions are on the increase. The local knowledge of the GLM residents in regards to the climatic conditions is sophisticated and it is apparent that much thought and observation has gone into their perceptions (*ibid*).

According to Thompson (2008) a flood damages chronological list becomes evident that parts of the larger region have frequently been subject to climatic disasters and associated negative impacts. At the same time, also the residents of this region seem to have a specific type of resilience. They tend to rebuild and then continue to lead their lives as if nothing has happened (ibid).

According to the SAWS (2011) rainfall data, the GLM area has experienced 9 major flooding events between 1981 and 2006 (refer to Table 11).

Table 11: Flood frequency data for the GLM

Year	**Floods (mm)**
1981	205.1
1992	190.2
1994	152.9
2003	214.7
2004	219
2005	78.9
2006	79.9
2006	333.4
2007	512

Source: Adapted from SAWS (2011).

Table 11 indicates various amounts rainfall received by the GLM. Each flood event has its own magnitude and density (Smith & Greenaway, 1993). The trend line in Figure 7 shows that from 1981 to 1992, there were constant high amounts of flood events recorded. While from 1994 to 2007 there was a significant decrease in flood events occurrence in the GLM. The higher the flood probability, the more property could get damaged. The lowest water level floods were 604mm in 2005 and the highest 1281mm in 1981. During the years that the GLM receives high flood events, Water entering human built structures cause more property damage. Resulting into, furniture being submerged in water, floors and walls having cracks, and anything that comes in contact with the water becomes damaged or lost. Flooding of automobiles usually results in damage that cannot easily be repaired. After retreat of the floodwaters everything is usually covered with a thick layer of stream deposited mud, including the interior of buildings. The flood loss may make the insurance companies to increase insurance premiums. While in the informal settlement corruption may arise from misusing of flood relief funds. A decrease in floods means a decrease in property damage and loss (Smith & Greenaway, 1993).

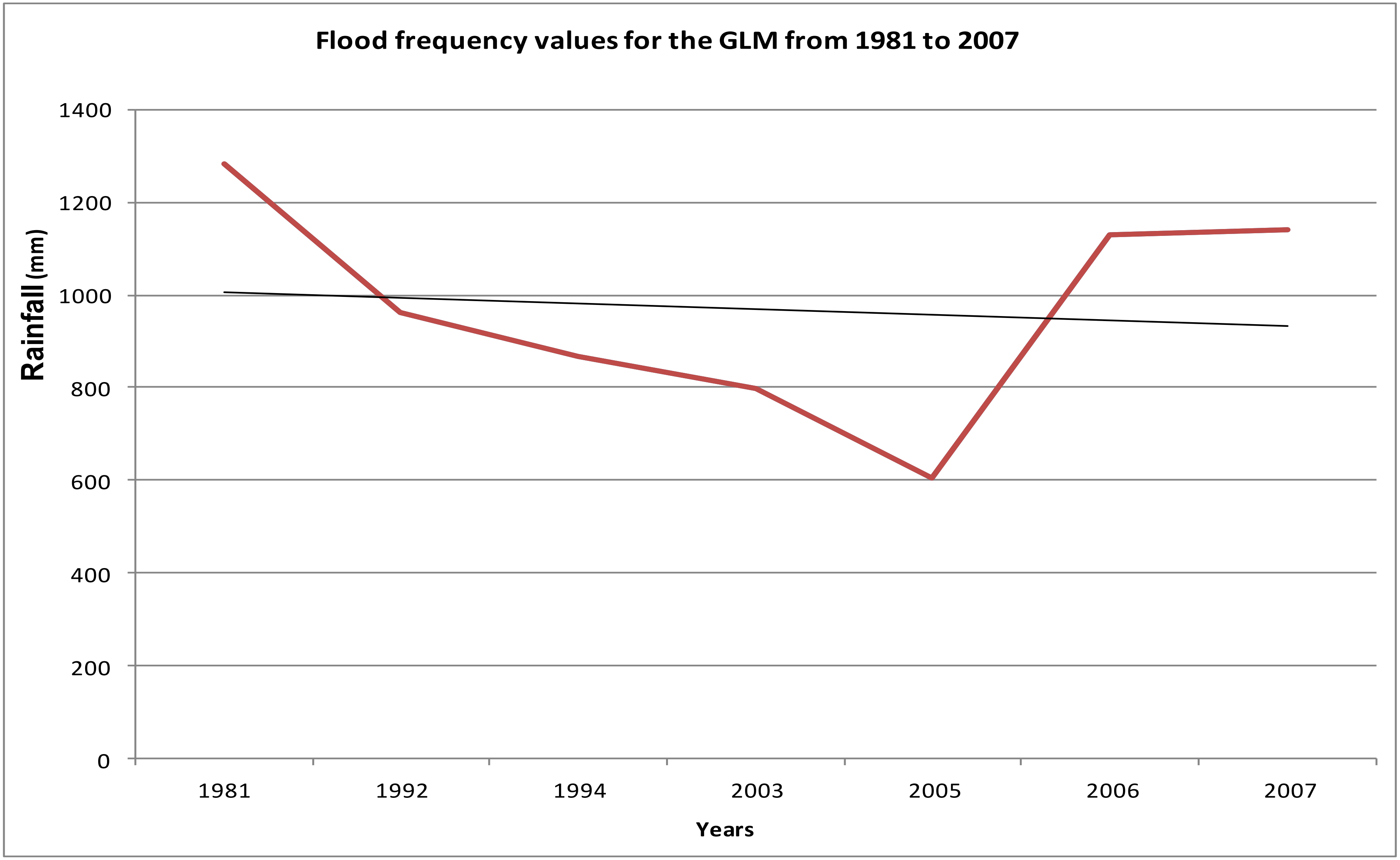


Figure 8: Flood frequency values from 1981 to 2007

From Figure 8, the research has identified 9 flood events from 1981 to 2007. There have possibly been others, which were never reported. The flood events severity may increase the level of damage, which may be related to the increase in population and construction of roads, railways and new housing developments (Njoh, 2006).

In 1981 the GLM experienced the flood events, which left the area with property developmental setbacks. In 1992 there was a cunning repeat of 'unusual' snow weather with snow falling as low as 900m above sea level. At the time the local emergency services responded to an accident in the mountains when a car crashed 500m down the Outeniqua cliffs, near the George.

According to (Gouws, Reyneke, Tempelhoff, Van Eeden, Van Niekerk, & Wuriga, 2005) in 2005/06 the December holidays along the Southern Cape Coast were severely curtailed by stormy weather and heavy rains. At the time, there were indications that the extreme weather conditions were the result of a series of coastal lows that drifted into the interior and wreaked havoc. At the end of November 2007 the coastal region of the Western Cape was severely hit by stormy weather. In the southern Cape Coastal region damages were estimated to be in the vicinity of more than R631 million (which amounts approximately UK £52.6 million pounds) (Lourens, 2007).

During the 2007 floods, in the GLM, 550 people were housed in community halls and many more were handed food parcels. There were fears among some residents in the

Thembalethu, that their water had been contaminated, possibly by ground water from a local cemetery (Thompson, 2008).

According to Otto, (2009) floods particularly were traumatic to witness the suffering of these people during the disaster. The media was informed that the even could have a psychologically harmful effect on children who had been forced four times, since 2003, to flee from tidal waves. In September 2008, a combination of factors such as swells of up to 9m close to the shore, occurrence of springtide, storms out at sea and subsequent storm winds, wreaked havoc in many parts of the GLM. There are psychological impacts to the survivors of floods in the GLM, but this research will only focus on the insurance companies and the floods risks.

4.2.5 Summary of findings of the SAWS data

From the analysed data, the GLM receives high rainfall yearly; the annual rainfall graph illustrated that very well. The trend line in the annual rainfall graph shows that there has been an increase in rainfall in the GLM. Table 9 illustrates that precipitation is high, during spring and winter, while low in autumn and summer, hence high flood occurrence is expected. There is a co-relationship between high rainfall and infrastructural damage in the GLM. This is evident in for example the highest recorded monthly rainfall of 512mm in November 2007, which is when the very high flood-included estimated insurance loss of over R3, 154,000 (which amounts approximately UK £26.3 million pounds) occurred. The high rainfall distribution may be caused by urban heat island, which might have warmer temperatures, resulting from the heat absorbing properties of concrete and asphalt, as well as the lack of shade and evaporative cooling from vegetation. The findings can also be used by the insurance industry to assess and estimate risk profiles, in order to set premiums according to the level of exposure to rainfall received in the GLM. Similarly, the findings can be used, to simply regulate the floodplains and make sure that the community knows the degree of flood exposure.

4.3 ANALYSIS AND INTERPRETATION OF DATA COLLECTED THROUGH THE TRANSECT WALK

4.3.1 Transect walk and photo analysis

The George Herald local newspaper (2007) was consulted to provide the flood damage photos of the GLM. The pictures were taken from 2005 to 2007. The intention, procedures, and the findings of the transect walks are outlined as follows:

Intention: The purpose of the transect walks was to identify the flood damage on infrastructure. More specifically, to give a picture of how floods damage the properties in the GLM. It also provided an opportunity to observe the consequences of inhabiting floodplains.

Procedures: The local newspaper captured the flood damage pictures during 2005 and 2007 and the other photos were captured when the transect walk was conducted during 2008.

Findings:

Properties Damaged: It was observed that most buildings that were damaged were located near rivers and streams both through the transect walk and the photo provided by the local newspaper. The study also detected that most properties in the GLM are build in the 1:100 year flood line.

According to Thampapillai and Musgrave (1985), flood insurance in South Africa is supposed to have the following benefits for society: make floodplain residents aware of the risks involved in settling on a floodplain, should complement structural measures by removing risks and must create environmental benefits by not interfering with nature.

Photos of the properties that were flood damaged during the 2005 and 2007 in the GLM are illustrated below:

Photo 1: Photo of flood-damaged property in Glentana near Groot Brak River, after 2006 floods (George Herald, 2007)

Photo 2: A flood-damaged house in Glentana constructed in a sand dune area during the 2006 floods near the Groot Brak River (George Herald, 2007)

Photo 3: Property located on a low-lying area along a water course in Heather Park during 2007 after floods (George Herald, 2007)

Photo 4: A wooden house build in a low-lying area near the Groot Brak River, which was immersed in water during the 2007 floods (George Herald, 2007).

It is such houses that claim form the insurance companies that their house contents especially the electrical appliances and wooden houses are damaged. Then the insurance companies need to replace the damaged items.

Road infrastructure: The roads and bridges were flooded, damaging the road infrastructure and cutting off residences of the GLM from other areas. The roadsides were eroded. The N2 from Wilderness to the GLM was muddy and slippery, causing the road to be temporarily closed for repairs and maintenance. The storm water systems had to be cleared out because of the debris flowing from mountains to rivers, via roads. The pictures below illustrate features observed on the road infrastructure:

Photo 5: Flooded municipal road in Waboomskraal during the 2005 floods (George Herald, 2007)

Photo 6: Storm water system filled with debris, near Thembalethu during the 2007 floods (George Herald, 2007)

Photo 7: Muddy-slippers (subset of landslides) in Outeniqua Mountains during the 2007 floods (George Herald, 2007)

Photo 8: A big pothole in a tar road in Heather Park after a storm event in 2006 (George Herald 2007)

Poor infrastructural designs and contractions always get damaged when floods occur in the GLM. This affected the transport services in the area, because residents have to detour and use alternative roads.

Houses developed near rivers and streams: According to Basson (2007), during floods, residents suffer the most flood damage and expect insurance agencies to pay out the claims. The more properties are developed in flood hazard zones, the more insurance companies will potentially have to pay out for flood damage claims. Images of both formal and informal dwellings that were constructed near rivers and streams that are affected by floods are indicated in photos 9 and 10.

Photo 9: An informal house that was built near a fast-flowing stream in Thembalethu after the 2007 floods (George Herald, 2007)

Photo 10: Houses in an estuary that were flooded after the 2006-2007 storms (George Herald, 2007)

Riverside zones: The rivers in the GLM experienced high volumes of water and debris causing the river banks to expand. Soil was eroded, vegetation was lost, and water animals were washed away. Photos 11 and 12 illustrate some of the impacts of recent storms.

Photo 11: A view of some of the debris that flowed via rivers into Heroldsbaai during the storms of 2006-2007 (George Herald, 2007)

Photo 12: Example of the high velocity and volume of water flowing in the Groot Brak river during the 2006/07 flood (George Herald, 2007)

It is evident that floods have done more harm than good to the GLM physical infrastructure. The photos showed, various physical infrastructure damage experienced by floods. The damaged properties have insurance policies except for the informal house in Thembalethu. One can just imagine the amounts of money that would be paid by the insurance companies after floods.

4.3.2 Summary of observations on transect walk and the photos

It is evident through the pictures provided that the GLM has a high rate floods sometimes affect the psychical structures. The 2005 to 2007 floods had huge impact on the property developments, since most houses were damaged by floods. Development on floodplains increases the vulnerability of property towards floods. Improved flood risk management techniques must be implemented to make the community flood resilient. From the images, it is clear that floods affect mostly the physical structures (houses, transport, business, roads and bridges).

4.4 ANALYSIS AND INTERPRETATION OF SAIA DATA

4.4.1 Introduction

The South African Insurance Association is the umbrella of the South African insurance industry. It represents almost all of the short-term insurance companies in South Africa and is authorized to negotiate on their behalf. It has 52 members. Table 12 lists the names of the insurers who directly carry risk for the GLM. The insurers cater for property insurance that covers flood risk for the municipality. Meanwhile; Table 13 lists the reinsurers who spread the loss of risk of the insurers. This section has analyzed the property damage for the GLM, using the data provided by the SAIA.

According to the SAIA (2007), from 2005 to 2007, there was a high record of property damage in the GLM caused by floods. The SAIA estimated that the total flood pay-outs were R3, 869,000, (which amounts approximately UK £3.22 million pounds), while the total flood claims were R 3, 154,000, (which amounts approximately UK £2.63 million pounds). The record year continues the trends of more frequent and destructive natural disasters, a pattern that has been documented by arguably the most informed players in the world-reinsurance companies. Munich Re (2003) observed the greater frequency of natural catastrophes which caused large losses.

Annexure C indicates the complete list of insurance companies that provide coverage against property loss from flooding. Most of this companies offer home contents policy that cover flood risk in the GLM The insurance companies determine risk factors for specific properties; insurers will often refer to topographical maps that denote lowlands and floodplains that are susceptible to flooding is full service insurance services.

Table 12: A list of re-insurers.

NAME OF THE RE-INSURES IN THE GLM
AFRICAN REINSURANCE CORPORATION (SA) LIMITED
AONRE REINSURANCE COMPANY LIMITED
SAXUM REINSURANCE LIMITED
SOUTH UNION REINSURANCE COMPANY LIMITED (UNDER CURATORSHIP)

Source: Adapted from Financial Services Board, (2008).

According to Michel-Kerjan and Kousky (2010) reinsurance is the means by which a direct insurance company seeks protection against the risk of losses; equivalently, re-insurers provide insurance to insurance companies. Due to their ability to specialise and achieve a better economy of scale than direct insurers, reinsurers are able to provide coverage for various types of risks ranging from sickness and death to natural disasters such as floods and thunderstorms.

Table 12 flood reinsurance companies are supposed to be cheaper than insurance companies in Annexure C, since reinsurance companies do not seek a lot of profit and has a better ability to smooth losses over time.

4.4.2 Housing

According to the URDR (2006), the house occupying statistics for the George Local Municipality is distributed as follows:

Table 13: Average household size, average number of rooms per household and average number of individuals per room for the GLM.

Wards Numbers	Average Household size	Average number of rooms	Average number of individuals per room
10404001	4	5	0.7
10404002	3	8	0.3
10404003	3	10	0.2
10404004	3	5	0.7
10404005	4	6	0.6
10404006	4	5	0.9
10404007	5	3	1.4
10404008	5	5	1.0
10404009	4	3	1.5
104040010	3	2	2.2
104040011	4	3	1.3
104040012	4	3	1.1
104040013	4	3	1.2
104040014	4	1	3.2
104040015	4	5	0.7
104040016	4	6	0.7
104040017	4	4	1.1
104040018	3	10	0.3
104040019	3	9	0.3
104040020	4	4	1.2
Average Total	**4**	**5**	**0.7**

Source: adapted from (URDR, 2006).

Based on the results shown in Table 13, the average number of individuals per room is 0, 7 persons in areas where there are generally insurance policies cover applicable, in formal houses. Formal structures have less people occupying the house, while informal shelters have more people living in it. The housing backlog is also estimated to be at least 12, 000 affordable housing units. According to the URDR (2006), the average monthly income in the GLM is around R 4, 724. Income is evenly distributed between high and middle incomers.

In the informal settlements of the GLM, most of the residents do not have flood insurance because they have low income and do not have additional expendable income to spend on “luxury items” such as insurance. In the informal settlements people settle near river banks and close to dams, due to their inability to purchase land at high cost in safe areas. The issue of insurance is not even considered, since informal settlers want job security first than other things. While on the other hand the formal houses have insurance policies that cover them against the natural and man-made disasters. The researched mainly focused on the formal structures that can afford flood insurance

4.4.3 Insurance claims for property damage in the GLM from 2006 to 2007

From Figure 9, the flood damage claims were grouped into five categories. Most flood claims in the GLM were recorded in Heather Park. This section analyzed each of the five categories (refer to Figure 10). From Table 14, there is generally a low estimated flood claim in each of the five categories compared to the flood payouts. This could be because property owners hire their own private risk assessors to estimate the degree of damage. However, when the insurance companies come and make the risk analysis, they pay according to their standards set out in the policy holder’s contract.

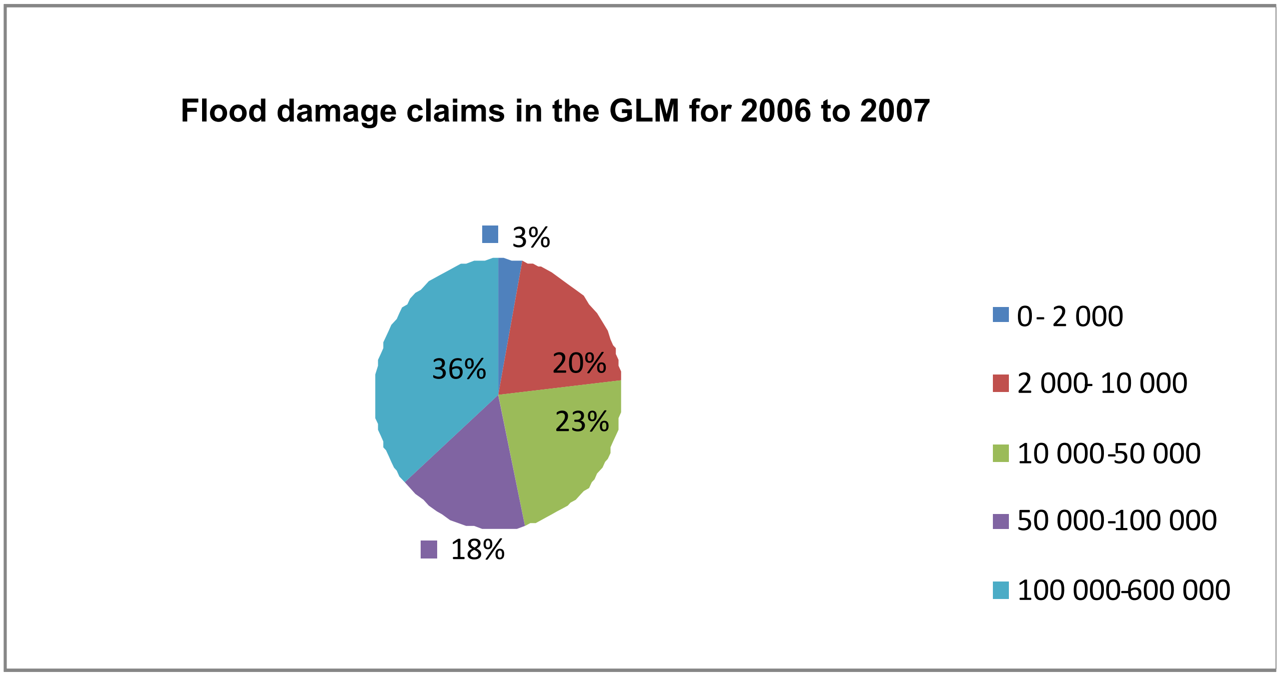


Figure 9: Flood damage claims per claim according to prescribed categories in the GLM for 2006 – 2007.

According to Figure 9, category 5 has claims of R1, 000,000. (which amounts approximately UK £83. thousand pounds). Making it the highest amount of claims received in the area; it occupies 37 percent of the total claims. Second position is category 3 with 23 percent of the flood claims. Category 2 takes the third position with the flood damage claims in the GLM estimated at R641, 000.000 (which amounts approximately UK £53.4 million pounds) (20 percent of the total claims). The fourth position is occupied by category 4 with 17 percent. The last position is taken up by category 1 with 3 percent.

GEORGE : Insurance Claims for Property Damage 2006 - 2007

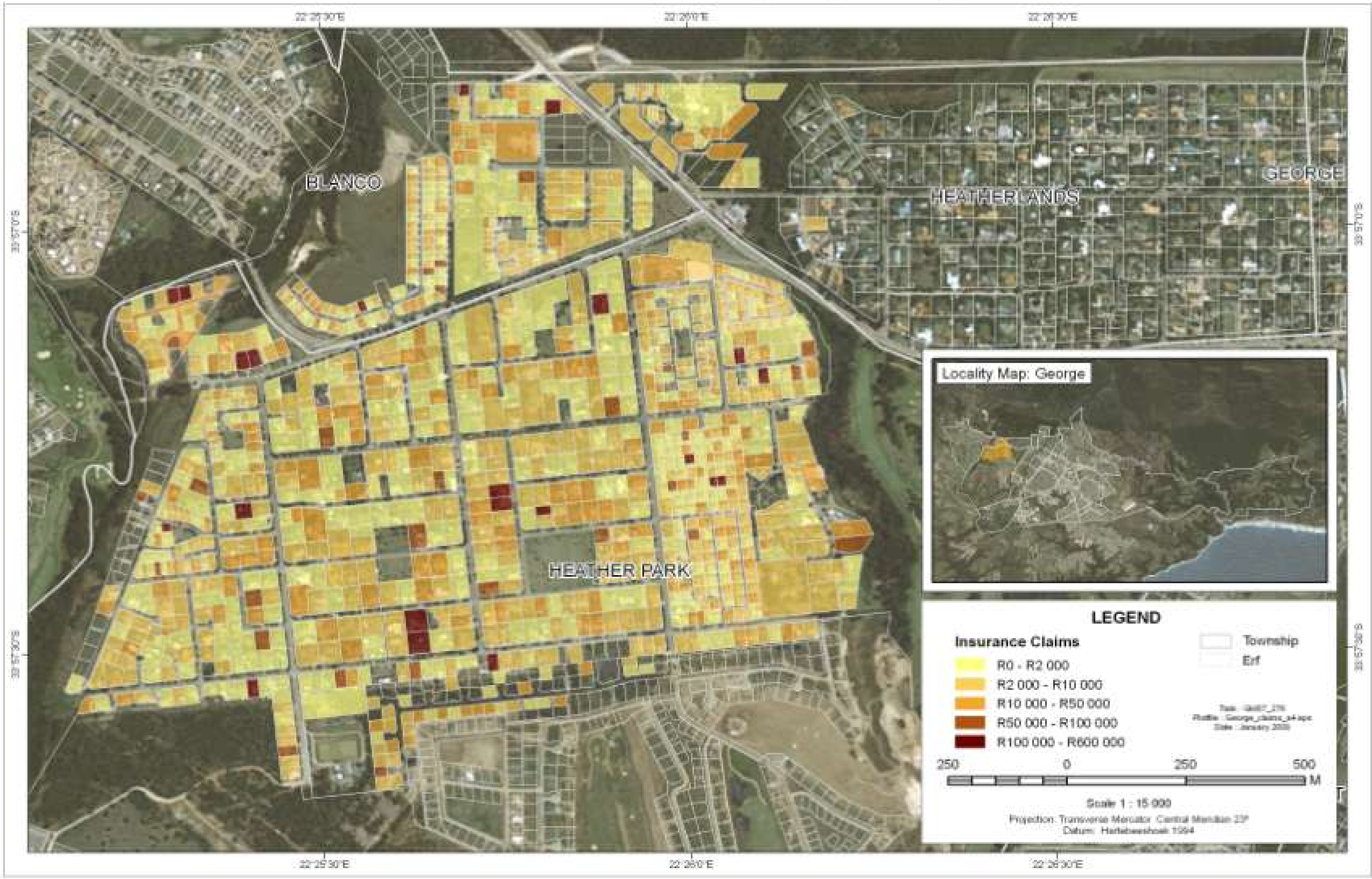


Figure 10: insurance claims for property damage 2006-2006 in the GLM.

From Figure 10, in the GLM, most claims are recorded originate from Heather Park; other areas are not densely pullulate by flood damage claims. There are many reasons why Heather Park received so many claims; some houses in Heather Park are situated near the rivers, below the 1:50 flood line, and in low lying areas. Photos 3 showed one house from Heather Park which was damaged severely just by being built in the 1:50 flood line. Heather Park residents complain about a lack of service delivery, and most flood claims are expected to come from Heather Park (Basson, 2007). After floods, an insurance assessor is assigned to assess the flood damage loss.

According to Munich Re (2003), the increasing magnitude of expected insurance loss, as well as the disparity between the size of annual premiums and the number of expected claims, questions the industry's long-term ability to deal with such risks. Besides, other characteristics of flood risk also raise the issue of their very insurability: flood hazards have fairly low levels of predictability. This, coupled with the often low level of insurance penetration and strong adverse selection effects, in cases of optional flood insurance, lowers the ability of insurers to pool the risk across society.

Table 14: The estimated flood claims and the payouts for the 2006 - 2007 flood damage in the GLM

Category	Estimated Loss	Paid-Outs
0 - 2 000	101,000	837,000
2 000 - 10 000	641,000	506,000
10 000 - 50 000	724,000	696,000
50 000 - 100 000	548,000	543,000
100 000 - 600 000	1,000,000	1,000,000
Total	**3, 154,000**	**3, 869,000**

Source: Adapted from (SAIA, 2007).

Table 14 shows the total cost spent on average from 2006 to 2007 only on flood risk in the GLM. According to the SAIA (2007), there is an increase in flood frequency and severity in the GLM. The frequent occurrence of floods in industrial and residential areas urged the flood risk assessment process to be further developed. As flood risk is increasing, it becomes increasingly important to assess and analyse the resulting loss, which provides the basis for long term management decisions. Several major components are featured in the risk assessment, mainly: hazard, referring to frequency of induction at varying depth and severity of the event, and exposure and vulnerability of the property exposed to flooding. The gathering of flood data helps to calculate the severity. That data can then be overlaid to estimate the degree of exposure. Frequency remains much harder to evaluate (Munich Re, 2003).

4.4.4 Insurance payouts for property damage in the GLM from 2006 to 2007

According to Parklina (2003), the increase and severity of floods in the GLM constitutes challenges for the insurance industry and forces it to react to quite new loss dimensions, as the loss trends continue to deteriorate.

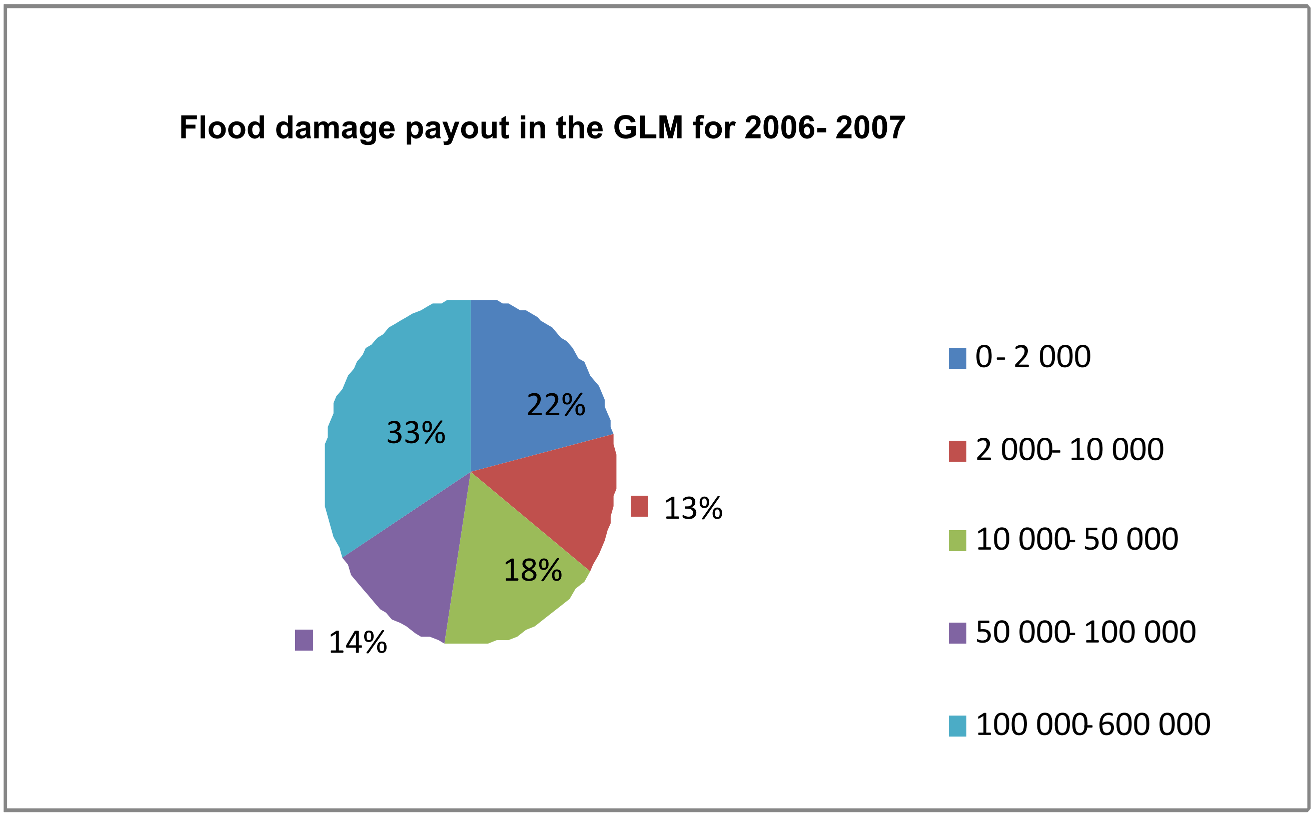


Figure 11: Flood damage payouts per claim according to the 5 categories in the GLM for 2006 - 2007

In Figure 11 above, the flood payouts are distributed as follows: the highest payout was recorded in category 5 with an estimated payout of R1, 000,000, (which amounts approximately UK £ 83.thousand pounds), which is less than the amount of loss in the claim category. In this category, it means that the normal claims were made but the insurance paid according to their standards in terms of the degree of damage stated in the insurers' contract. In position two, was the first category with R837, 000.00 (which amounts approximately UK £ 69.8 thousand pounds) payouts, this category differs dramatically from others, since the payouts are extremely higher than the claims. Category three occupies the third position with 18 percent of the payouts. The forth position is occupied by category four with an estimated amount of R543, 000.00 (which amounts approximately UK £ 45.3 thousand pounds), and 14 percent of the payouts. Lastly, is category two with payout amounts of R506, 000.00 (which amounts approximately UK £ 42.2 thousand pounds).

The increased severity and frequency of flood loss is mainly caused by the following (Parklina, 2003):

- The increase in the vulnerability of structures, goods, and infrastructure in flood-prone areas due to inappropriate land use and lack, or failure, of flood protection measures; high population density on floodplains and these highly vulnerable cities carry tremendous loss potential. The continued urban and industrial development in flood risk areas, resulting in increased concentration of values, is also likely to aggravate the extent of loss in the threatened areas.

GEORGE : Insurance Payout for Property Damage 2006 - 2007

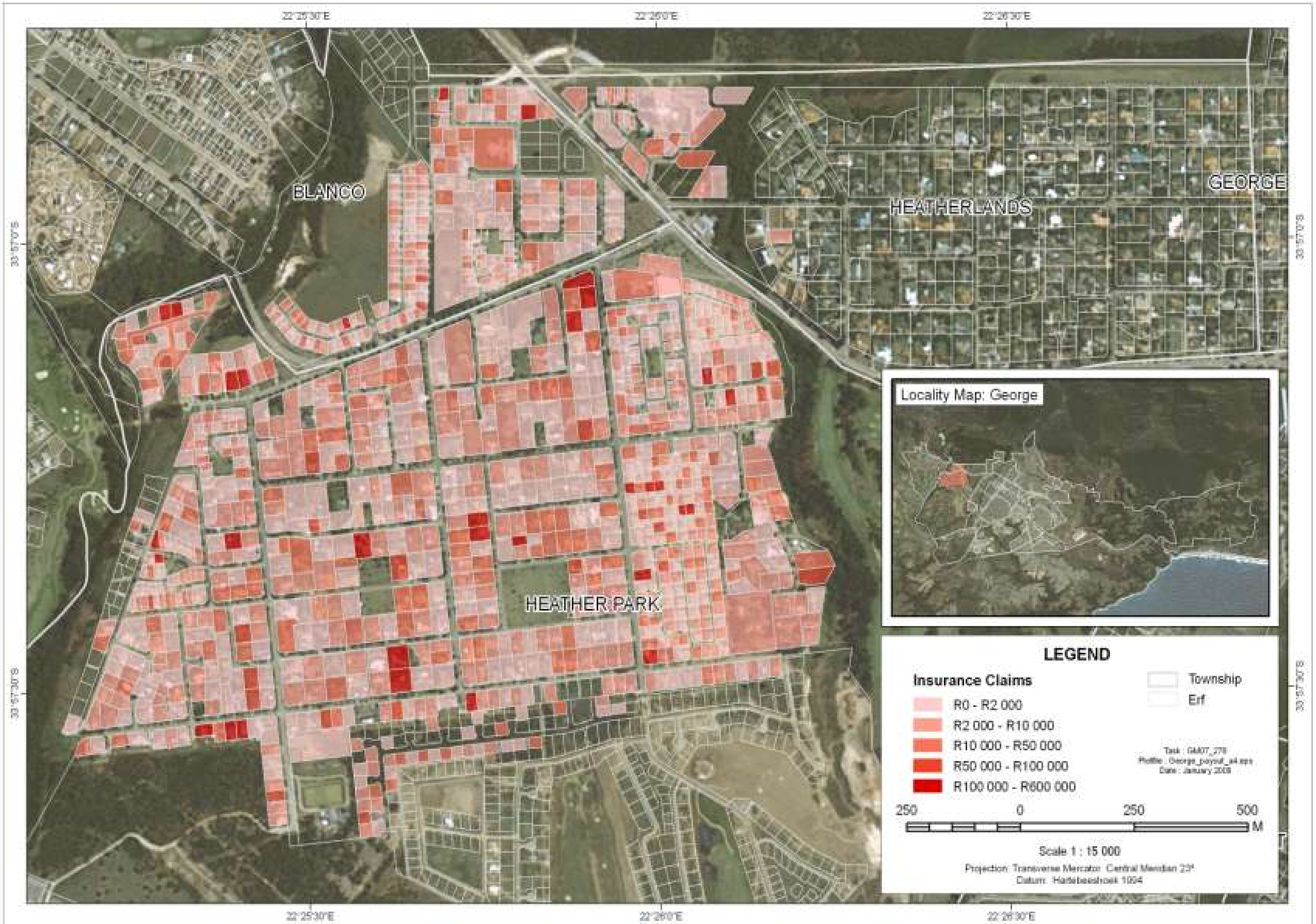


Figure 12: insurance pay-outs for property damage 2006-2006 in the GLM.

The majority of the white population live in suburbs close to urban opportunities, and high-income people of all races live in exclusive coastal resorts and golf estates. Hence most payouts are in areas such as Heather Park, Heather lands, Blanco and Glentana (Refer to Figure 12). People who built too close to the sea and have removed vegetation that disrupted natural drainage systems, thereby concentrating run-off that becomes unstoppable. These practices are inflating the reaction of nature to heavy rains, resulting in heavy losses of property and infrastructure.

The GLM is connected to the Garden Route Dam system. During floods some towns gets cut-off from their water supply – resulting in water shortages. The coastline also limited access to towns in the area. During 2006/2007 storms, the storm water pipes in Glentana burst; the sea level rose as combined spring-tide and inland run-off flooded streets and houses in Wilderness and Harold's Bay; and the sand dunes in Wilderness are being washed away. It is even expected that the value of properties adjacent to the beach may decrease in future (Carstens, 2008).

The storms are more intense and heavy and the natural environment does not recover from the damage in time to face the next severe weather event. The many ravines in the district contribute to channelling the strong run-off and flash floods after heavy downpours. This increased intensity in precipitation and resultant increase in run-off cause landslides due to saturated land, eroding of the riverbanks, and damage to irrigation infrastructure and pumps.

According to FEMA (2002), it is necessary to weigh the cost of flood mitigation measures against the benefits in reducing flood damage. There are no enforceable flood migrations measures in the GLM. Severe weather events could destroy properties next to a river or in a floodplain. Although many informal home owners in the GLM cannot afford to insure their properties against floods, the funds usually does not cover the entire amount that the damage that may incur. For this purpose, COGTA often assist with relief funds. Homeowners may not be able to continue with normal services because of the wet weather, or they may be cut-off from the rest of the world if the roads and bridges are washed away. But government in most cases try harder to offer humanitarian assistance to those affected most.

4.4.5 Summary of SAIA findings

The GLM received 281 flood insurance claims between 2005 and 2007. Heather Park recorded 250 buildings being damaged by floods; hence the area has made more flood insurance claims and received more payouts than the rest of the GLM. The insurance companies paid out more funds than the original claims logged by the community. The area has more flood payouts than claims. Flood mitigation measures need to be implemented to reduce flood damage in the area, based on the fact that the insurance industry lost a total of R 3, 869,000(which amounts approximately UK £ 3.22 million pounds). Flood disasters set back developmental programmes in the GLM, since stormwater systems, properties, agricultural land, roads and bridges were destroyed and took two years to recover. The buildings that were affected are highlighted and displayed in Figure 10 and 12.

4.5 ANALYSIS AND INTERPRETATION FOR THE SPECIALISTS QUESTIONNAIRE

Specialists were asked to answer a self-administrated questionnaire which addressed the sub-problems. A summary of the specialist's responses is depicted in Table 16. The questionnaire is attached as Annexure B. The specialist's responses are discussed as follows:

4.5.1 Identification of the hazard

The questionnaire requested the specialists to identify a natural or man-made weather-related hazard which poses the most risk to the community of the GLM. Most specialists identified floods, while others identified strong cut-off systems in the GLM. The specialists agreed that floods pose more risk to livelihood and infrastructure in the GLM.

4.5.2 Flood risk in the GLM

The specialists outlined challenges posed by flood risk in the GLM. The challenges are outlined in Table 15 and are discussed as follows:

Hydrologists: stated that there is a need for the insurance companies to play a role in flood risk reduction programmes. Flood insurance companies may relieve the government from paying flood recovery funds to the affected community. Society must be discouraged from develop flood prone areas. Floods lead to loss of lives and property, not to mention that intangible resources can be lost due to floods.

Infrastructural and town engineers: mentioned that civil services must design and build in compliance with the local authorities specifications laid out for commercial industries. There is a need for the town planners to consult with other stakeholders before developing an area. Communities must always be represented when housing decisions are made. The public must be made aware of the consequences of settling in flood prone areas. Infrastructural designs must be made to withstand flood pressures. Communities must settle in areas which are outside the 1:50 year flood line, to make the GLM flood resilient. Low incomers receive less housing funds, causing them to settle in flood vulnerable locations.

SAIA representatives: stated that flood impact assessments should be conducted during, and after, floods. Late impact assessment can estimate false results. The insurance industries need to send assessors during floods to assess the damage loss so as to avoid high unpaid claims. Flood survivors must be assisted by neighbouring cities and towns to avoid long term psychological impact. The time interval for flood claims to be processed must not be long. Service providers and relief agencies must be available during floods to assist the flood victims.

Meteorologists: said that there is a need for accurate forecasts to provide the community with early warning signs, in order to evacuate in time.

Table 15: Response from specialists

Specialist(s)	**Identified Hazard**	**Major Challenges With Flood Risks And Their Impact On Insurance In George Local Municipality**	**Possible Solution**
Hydrologists	Floods	Water damage to property.	Exclude cover from properties that are built within the 50 year flood line. Prevent new developments within the 100 year flood line.
Infrastructural and Town Engineers	Floods	All civil services are supposed to design and build to comply with specifications and norms laid down for the industry. The maintenance of services must ensure that the design capacities are sustained. Communities settle in areas below 1:50 year flood level. Lack of sufficient funds for low income housing; resulting in the construction of storm water systems performing dissatisfactory during flooding.	To ensure that services are constructed to the normally expected industry standards. Proper maintenance programmes. Town planners and Councils must ensure that settlement below 1/50 does not take place. More funds should be allocated.
SAIA representatives	Floods	Impact assessment conducted after floods have subsided and late processing of claims. Assisting flood survivors and time interval available for claims and availability of service providers.	Mobilization of units from head offices. Contacting contractors from outside to assist in repairs.
Meteorologists	Floods	Accurate forecasts.	Improved numerical weather models to forecast flood producing weather systems.

From Table 15, all specialist identified floods as the most significant risk in the GLM. Annually, floods destroy and damage properties, developmental initiative estate projects, roads and stormwater infrastructure. Therefore, making the GLM property owners to claim flood damages, either from the private insurance companies or the government. The GLM residents are aware of the flood degree they face, and they always include homeowners insurance which makes provision for flood damage coverage.

4.5.3 Solutions to address the identified problems

The questionnaire from the specialists outlined possible solutions to the problems identified. The possible solutions are outlined in Table 15 and are discussed as follows: Hydrologists: emphasized that flood insurance must exclude insurance covers for properties that are built inside the 50 year flood line. The local municipality must discourage new developments within the 100 year flood line.

Infrastructural and town engineers: suggested that the GLM must ensure that services are constructed to normal expected industry standards, making use of police to enforce the municipal by-laws. Engineers must develop proper maintenance programmes. The local authorities must provide safe and sustainable housing to the community.

SAIA representatives: suggested that during floods, the insurance companies must mobilize units to assist flood victims. A list of contractors from outside the affected location must be contacted to assist with repairs immediately after flooding has subsided. Meteorologists: pointed out that research needs to be done to improve numerical weather models for forecasting floods.

4.5.4 Specialists priority graph of services affected by floods in the GLM

Annexure B was used to gather data from the specialists. The specialists were required to prioritize sectors which were affected by floods in the GLM. They used numbers from 1 to 10, where 1 was equivalent to mostly affected and 10 referred to the least affected. The totals values from all expected were added up and divided by the total number of services identified. The averages where then converted into percentages according to each service. The results are presented below.

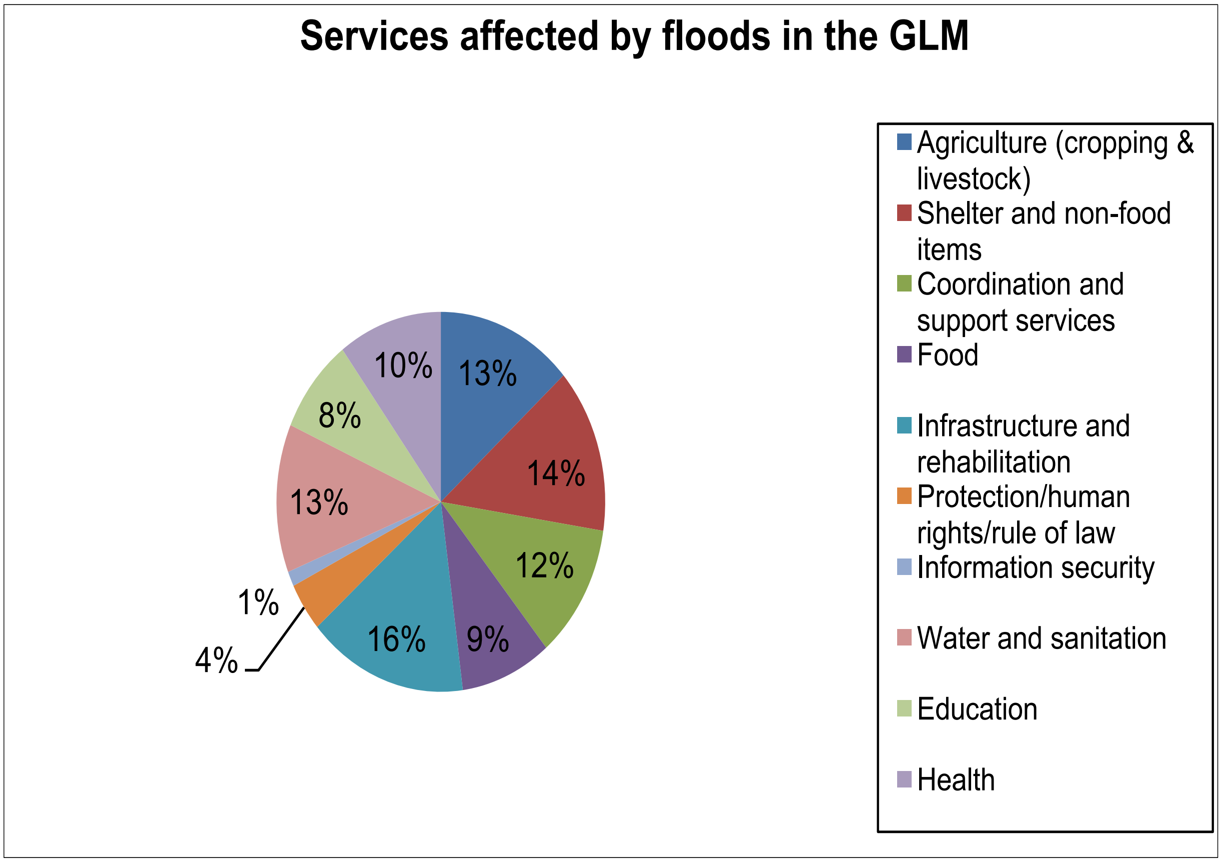


Figure 13: Specialists' priority graph of services (environmental, socio-economic and physical) at the GLM which are affected by floods.

4.5.4.1 Infrastructure and rehabilitation thereof

Services that are affected by floods are outlined in Figure 13; Infrastructure and rehabilitation appear to be the first priority on the specialists list. These services contribute 17 percent of the total pie chart. According to Basson (2007), the GLM is rapidly expanding, the engineers and town planners, together with the local municipality; make sure that the municipality infrastructure is resistant towards natural and man-made disasters. Simply designing non-disaster resistant structures can help reduce the impact of disasters on the local population. The National Treasury allocates R200 million (which amounts approximately UK £ 16 million pounds) to the Western Cape towards infrastructure development (repair and improvements). R71 million (which amounts approximately UK £ 5.9 million pounds) was spent in 2007 on infrastructure recovery, from the lessons learned, the GLM now invests in infrastructure improvement but can sometimes be limited by funds from the National Treasury. It is the responsibility of the local municipality to enforce building standards regulations and acts that do not allow any developments under the 35m, or the 1 in 50 year's floodplain. If individuals wish to develop such areas, the municipality would not be responsible for assisting with any damages (Browne & Hoyt, 2000).

The poorer communities affirmed their desire to move closer to town and facilities with specific emphasis to being housed north of the N2 national road as opposed to south of the N2, because there are better services in central George than in decentralised areas. Communities already living in the vicinity of George central raised their concerns about the value of their property being affected by low-cost housing encroaching on municipal land. The specialist's choice and the pictures are in agreement that infrastructure and rehabilitation are mostly damaged by floods.

4.5.4.2 Shelter and non-food items

The second priority, at 14 percent, is shelter and non-food items. According to the Associated Press (2006), during the 2006 floods in August, homes were flooded, sending scores of families to seek shelter at a community centre and school.

Properties that are constructed on floodplains and other flood prone areas are normally severely affected by floods. Other resources, both movable and stationary, are normally affected most if the water enters buildings. Most houses, which are insured, are normally for those residents who live in formal settlements (FEMA, 2006).

The Associated Press (2006) stated that heavy rains and floods cause houses to collapse and/or develop major cracks, as well as sometimes have their roofs blown off. The majority of the inhabitants affected were residents of the George South and Heather Park. Heather Park had the most property damage claims from the insurance companies. Property which is located in floodplains is likely to be affected most by floods, and the damage can be severe. This statement concurs with the transect walk analysis, as it was seen that some property was severely damaged.

4.5.4.3 Agriculture

In recent years farmers have started with intense farming practices on flood plains, because of the adequate water supply and fertile land these flood plains provide.

Unfortunately, agricultural prosperity has taken a hefty toll on the natural environment, especially on river systems. Agriculture is considered a medium sized sector of the local economy with relative local importance. It is an irreplaceable commodity. Agriculture is a major land use in the GLM, covering a large percentage of its land, particularly west of the municipality. Forestry in the GLM includes both commercial forestry and indigenous forestry areas. Commercial forestry takes place predominantly in the undulating foothills between the mountainous areas far north and the plateau, where topographic (steep slopes), soil (deep, fertile soils) and climatic conditions (high rainfall) are most suited to forestry activity. Change in land use patterns is the result of change in human behaviour driven by socio-economic forces and natural floods. A balance between the demand for urban expansion and the protection of existing high potential agricultural land must be achieved. An imbalance, in terms of floods damage may cause the GLM to suffer with their agricultural production (George Local Municipality, 2005).

Agriculture occupied the third position, with 13 percent. According to the FAO (1992), the current pattern of land management and utilization, as well as the increasing demand for land, presents numerous environmental problems. The most serious of these is soil degradation, resulting from developmental activities and floods. This has led to declines in productivity and agricultural earnings in many areas. When floods damage agricultural products, the insurance pays for the damage loss. However, if farmers use correct flood mitigation measures to lessen the damage, then the environment will be safe from land degradation. Incorrect agricultural and land use management has a negative impact on the environment. Insurance must not be used as an excuse to damage the environment.

According to News24 (2003), the floodwaters have virtually destroyed irrigation infrastructure, pipelines and drip systems. Vineyards may be under mud, and erosion has left the land spoilt in the GLM. The direct economic loss sustained as the result of severe weather and flood damage exceeded R210 million (which amounts approximately UK £ 17.5 million pounds) for the year 2006-2007 The majority of this loss was borne by the private sector, primarily farmers (Disaster Mitigation for Sustainable Livelihoods Programmes, 2003). During floods, services get immersed in water causing agricultural activities to come to a halt.

4.5.4.4 Water and sanitation

The provision of potable water is one of the primary requirements for the basic quality of life. The main source of potable water in the GLM is the Garden Route Dam in the Swart river. The Garden Route Dam has an assured supply capacity of approximately 37ml/day (Millilitres per day) (9mm^3. for the year) (George Local Municipality 2005). The Garden Route Dam has a present registered use of 30ml/day and an extraction of 7.3ml/ day is permitted from the Kaaimans river. Another much smaller source of water for George is the Touws river. There are also eleven reservoirs and two water towers supplying the old George system (George Local Municipality, 2004).

As the Municipality is already experiencing difficulty in conveying peak demands from the Garden Route Dam to the GLM it has initiated the provision of additional pumping capacity at the existing pump station below the dam. The additional pipeline will also provide additional security in the event of pipe failures. Since the construction of the Garden Route Dam in 1979, the original Water Use in George water consumption in George has dramatically increased at an average annual rate of 7 percent per year from 1980 to 2004. The water demand of George has grown at an average rate of 4, 5 percent per annum since 1988 (George Local Municipality, 2004).

The average annual growth rate of water demand that can be expected up to 2030 has been estimated at about 6 percent. This would result in a demand of about 40 Mm3 per annum in 2030. If a slower growth rate were to be experienced, the corresponding water demand in 2030 would be approximately 28Cubic Millimetres (mm^3) per annum (George Local Municipality, 2005). In the near future the no purified water storage capacity of the municipality needs to be extended.

The drainage area of the existing sewerage system encompasses the old municipal area of George, Hoekwil, Kleinkrantz, Phase one in Wilderness and the Wilderness Inn area in Wilderness. The GLM has two large Wastewater Treatment Works (WWTW), namely the Gwaing WWTW and the Outeniqua WWTW.GLM also has a smaller WWTW at Kleinkrantz. Neither of the WWTW have a market for their sludge. Sludge is disposed of and stored on the WWTW sites. Sludge from the George WWTWs has reportedly very high iron content and an inconsistent pH (Potential Hydrogen) which makes it undesirable for composting. No sewage sludge is disposed of at the local solid waste disposal facilities. The storage, disposal and minimisation of sewage sludge require further investigation as resources are limited (George Local Municipality, 2005).

Poor hygiene and limited water and sanitation resources lead to the poor health of the community members. This service occupied 13 percent of those affected by floods. The most significant environmental impact of this year's floods season, however, will be the crop losses during the current agricultural season (Scott, 2008). Water systems must be designed in accordance to standards in the National Water Act, No 36 of 1998. According to the United Nations World Food Programme (2007), the designs must take into account the following factors: population size, local infrastructure type, pressure, rainfall patterns, floodplains, and contour management.

According to the DiMP (2003), better planning and monitoring of the river flows can help in terms of water management systems. The water infrastructure design must be installed in appropriate places to avoid further damage or pressure by man-made or natural events. If floods damage the water infrastructure, the sanitation of the community will be highly affected which might lead to ill health in the area. Human consumption of any contaminated water can affect people's health and cause outbreaks of cholera and other water-borne diseases (United Nations Office for the Coordination of Humanitarian Affairs, 2007). Contaminated water can result in water-borne diseases, causing the exhaustion of health care facilities during flooding.

4.5.4.5 Coordination and support services

The coordination and support services sector occupies 11percent of those affected by floods. The GLM is revising its contingency plans with support from the Organisation for the Coordination of Humanitarian Affairs for Southern Africa (OCHA ROSA) and the Bureau for Crisis Prevention and Recovery (BCPR). Given the propensity for increased levels of food insecurity, coupled with heavy rains and flooding annually, the plan will focus on humanitarian interventions aimed at disaster preparedness and response activities.

In 2005 the engineering company Geustyn Loubser Streicher (GLS) was subcontracted by the GLM to assess flood damage and to estimate the probabilities, frequencies, intensities and magnitudes of floods. The company provided this study with useful flood risk information. The GLM is responsible for coordinating during disaster events, for better rescue and evacuation of the affected population during flood disasters. The municipality provides food parcels, temporary shelter, and relief services until the community has reached a state of calmness (Basson, 2007). A number of government departments (such as the DWAF, the South African Police Services, the Department of Agriculture, the Department of Education and the Department of Social Development), as well as non-government organizations (NGO’s) and the private sector, are called in to form a forum called the Joint Operation Centre (JOC) to further assist with managing the incident.

The specialists are required to come together during, and after, a flood to assist the municipality in better managing the affected sectors. Disaster management officers coordinate the process by offering better management skills. All other departments are supposed to cooperate. Despite other departments having policies to deal with various incidents, overall, the Disaster Management Act, No 57 of 2002 governs the distribution of assistance in the case of a disaster. Coordinating services during a flooding season can be a problem, as some communities are cut off and communication systems might be severely affected.

4.5.4.6 Health

The flood impact on health varies between populations for reasons relating to population vulnerability and the type of flood event. According to Hajat, Ebi and Kovats (2003) as well as Western (1982), the existing demands for health facilities are not met, largely as a result of funding constraints from the local government. The GLM health-services sector is in many ways a localised facility, with the capacity strained by the local residents.

According to Heller, Colosimo and Antunes (2003), floods vary greatly in their character and size, depending on the vulnerability of the populations that are affected. Some floods are catastrophic and affect thousands of people who may have little capacity to protect themselves, as was the case in Mozambique in 2000, Bangladesh in 2004, and the GLM in 2006 and 2007. The municipality experiences only the long-term adverse impact of floods, since health resources are mostly mobiles during, and after, floods (Basson, 2007). Human or animal ill-health can be caused by contaminated water, which may results into long terms health effects The mobilization of health resources is essential for people to receive assistance immediately. The GLM has eight community health centres / clinics, and two private hospitals. Should flood damage occur at any of these Places, it can leave the community vulnerable to disease outbreaks, deaths and pandemics. Epidemic: is an outbreak of disease that attacks many people's at about the same time and may spread through one or several communities while pandemic: When an epidemic spreads throughout the world.

4.5.4.7 Food

According to Cooke, Roger and Kousky (2009), food security, based on production and supply are affected throughout the year, as crops and livestock become immersed in water. Most agricultural activities stop production during flooding. Floods can cause a community to experience a 'loss of earnings'. In the GLM flood damage affects the local economic activities by simply destroying the infrastructure that the community relies on for production. The infrastructure necessary to produce consumables for humans can be affected, which can make food production high and ultimately cause food prices to increase. Fortunately floods do not affect the whole Western Cape Province, but only a part of the province. The even distribution of food parcels to the community can be problem if the municipality experience high volumes of rainfalls continuously, affecting the food transportation routes. Food production companies may loss profits and food may perish due to location inaccessibility to during flood events.

4.5.4.8 Education

According to Shabman (2009), during floods, educational facilities in the GLM may get inundated, thereby cutting nearby communities off from academic activities. Primary school, day care centres, colleges, secondary schools had to be halted during the 2006/07 flooding season for a period of two weeks, because roads were closed. Stationery, and other academic materials, might be immersed in water. If floods affect school buildings, learners wait until all the water is cleared from the educational buildings. Educational facilities, which might be damaged, may be self-insured by the schools, if not; the school will seek external assistance to replace the damaged goods. Other reasons for a temporary school closure may be due to flooded roads, communication lines being cut down, and electricity poles being cut off. Normally, after such conditions, GLM learners and educators create a school schedule than will make up for the lost school days. Mooiman (2007) stated that the suspension of learning, due to natural or man-made disasters, is uncontrollable; however, the Department of Education can make contingency plans. Pupils' education can be affected, since flooded roads make it impossible for scholars to get to school.

4.5.4.9 Human basic rights

The population of South Africa is protected by the Constitution of the Republic of South Africa, No 108 of 1996, which is the mother body of all South African acts. The Act stipulates that every individual has the right to adequate housing, social security, and sufficient water and food. However, every right has its own limitations and it's up to individuals to abide by the law. It is useless to settle below a 1 in 50 year floodplain and then later request flood relief funds when an individual is flooded.

The Constitution and the Red book (engineering book that guides infrastructural designs) guide the infrastructural designers and people's rights in terms of settlement. The followings policies: the National Environmental Management Amendment Act, no 56 of 2002, the National Building Regulations and Building Standard Act, No.103 of 1977, and the red and blue book, provides guidelines in terms of choice of settlements in the GLM. Integrated development plans for the GLM need to compliment the land distribution laws without infringing on people's rights (DiMP, 2003).

Insurance companies should cover flood insurance in South Africa. The government would rather spend more funds annually on projects to reduce poverty, HIV/AIDS, and crime, than pay out compensation recovery funds to individuals who settle in flood prone areas, being aware of the consequences (SAIA, 2007).

There is good legislation in place to regulate the activities of GLM residents to develop in sensitive areas like flood plains, but unfortunately authorities do not enforce these laws consequently. Some formal residents may choose to stay on floodplains, while informal settlers may seek government assistance after being affected by floods.

4.5.4.10 Information security

Information technology takes the last position with 1 percent of the services affected by floods in the GLM. The GLM together with the insurance companies are responsible for capturing, analyzing, storing and disseminating the data to the media, public, and policy makers. The information can then be send to the NDMC database (Swiegers, 2007). Information should be made available to the public for researchers to study weather patterns and propose suitable risk reduction measures and plans. According to a University of Cape Town study report (The Cutt-off Low, 2003), the Department of Communications must distribute and regulate information. The University of Cape Town study report (*ibid*) mentioned that the protection of information must be a national priority. Learning institutions must conduct extensive research on flood patterns and further inform the media and decision makers of any predictions that might damage the environment. Private use of the rainfall and flood data can assist the commercial and agricultural sector in planning accordingly. According to the Constitution (1996), everyone has the right to access any information held by the state. The public, therefore, has the right to be warned in advance of any excessive weather conditions, to invest in mitigation measures against flood risk in the GLM.

4.5.5 Summary of specialists results

All the specialists identified floods as a hazard that poses risks to the George Local Municipality. Suggestive mitigation measures were outlined to reduce the flood risks in the GLM. The choice to settle below the 1:50 year flood line can badly affect all the identified sectors if proper policy guidelines are not in place. Local authorities and insurance industries must provide flood insurance that covers developments in hazard-prone areas. They should also make it a responsibility of the residents to purchase flood insurance to cover flood damage. Ten sectors, which are affected by floods, were identified.

The following sectors are negatively affected by floods: agriculture, shelter and non-food items, food, infrastructure and rehabilitation, water and sanitation, health, and education, this could be due to adverse impacts on profitability (for example, if a flood leads to a reduction in the operational efficiency of some machinery). Insurance premiums for people who settle in 1 in 50 year flood line should be greater than those for people who settle in less flood prone areas. The variation in flood insurance premiums will assist in controlling floodplain management. Insurance cannot be seen as a long-term mitigation tool, but rather a tool to assist government with flood relief funds. Avoidance of floodplain development can reduce the damage for all identified sectors.

4.6 SUMMARY OF FINDINGS

The research found that despite the high rainfall patterns in the GLM flood risks have adverse impacts on agriculture, physical infrastructure, environmental, economy and social systems. There is no clear communication regarding flood risk policies between the local government and insurance and/or reassurance companies. Flood damages are experienced annually by the insurance companies but there are initiatives to reduce the flood risks.

The legislation regarding flood risks is there in the GLM, but the implementation is not happening since there is no monitoring and control measure to enforce the legislation. International polices are more precise on flood insurance coverage than the GLM by-laws. Yes, the insurance companies in the GLM experience more pay-outs than making profits. Hence the community experiences more premium increase annually. There is a link between the high rainfall and the insurance pay-outs. The more the rainfall, the more the flood risk damage claims. Insurance companies carry the flood risks annually without government assistance, unless in public structures.

There is no analysis of the present effects of flood damage on the property, nor predictions on future flood damage implications for the GLM. Though flood risk assessments may have been done by the local disaster management, housing and town planning departments, the assessments are just integrated into development plans of the municipality. There is no iteration between or integration of flood insurance, local government and local community strategies in the GLM.

There are several sectors/services which are affected negatively by the occurrence of floods in the GLM, namely housing, health, food transportation and distribution, agriculture, education, water and sanitation. It was found that flood risks insurance in general, and flood risks specifically, remains sophisticated rhetoric not yet institutionalised in the GLM. Flood insurance companies are affected depressingly annually by the flood claims from the local municipality.

4.7 CONCLUSION

This chapter provided four different types of data sets. The rainfall analysis showed that the more the rainfall the more the probability of floods in the GLM, and that can increase the property damage. The GLM experiences more rainfall in winter and spring, making insurance companies to lose their profits. During the winter and spring insurance companies experience claims from the public and that have a negative impact on the economy of GLM. The transect walks showed evidence that the floods destroyed the properties and the infrastructure again showing the negative impact of floods on the socio-economic and environment of the GLM. There are high amounts of pay-out by the insurance companies to the community. The specialists identified flood challenges and threats, together with certain services which are highly affected by flood in the GLM.

CHAPTER FIVE

5. RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

The purpose of this study was to investigate the impact of floods on the insurance industry in the GLM. This chapter summarizes the study, and makes recommendations for further flood insurance research.

5.2 RECOMMENDATIONS

In order to adequately address the dynamic challenges of flood risk insurance, interventions at various levels are necessary. The following section will provide recommendations for the following categories: the local municipality, local communities and insurance companies.

5.2.1 Recommendations to local, provincial and national government

- Flood maps must be made available for the public, especially those who wish to develop areas below the 1:50 year flood line. That way the public can see the probability of flood occurrence in the floodplains.
- There should be changes in building regulations, or standards, to make them flood proof, thereby reducing property damage and loss.
- More comprehensive flood risk maps that have flood lines, must be made in the GLM to accurately estimate the flood risks.
- Land-use management measures that will make stricter limits on development in hazardous areas (fault zones; floodplains, hillsides prone to slippage), building regulations that ensure resilient buildings and infrastructure that can maintain essential services when a natural hazard occurs
- Local and international flood risk requirements must be translated into local initiatives with a concrete agenda and budget allocation for implementation.
- Though flood risk mitigation and adaptation should be integrated with other strategies, a dedicated person in GLM should monitor and report on initiatives.
- More awareness of flood risk vulnerability and flood risk reduction is created through marketing, communication and training.
- Although the need for flood plain management and capacity is called for in both policy and legislation, it remains an underfunded and even ignored function. Similarly, the research has found that local government does not see flood risk mitigation and adaptation as their responsibility.

- Local municipality must urgently conduct research of the possible impact of flood risks on local economic growth and property security.

5.2.2 Recommendations to communities

- Local communities must proactively become involved during planning processes in identifying local resources instrumental in flood risk reduction and early warning systems.
- The possible impact of flood risk will require adapting the general GLM community.
- Communities and private individuals should consider the benefits of utilising flood proofing techniques.
- Those living in vulnerable locations such as the slopes of hills, in valleys containing either the river or its tributaries and flood plains must build according to the municipal by-laws.
- Homes which are located lower than street level (as in Thembalethu, see Annexure A), and is a result of poor town planning, will have to be subjected to intense community and stakeholder participation in an effort to relocate them to safer ground
- To reduce losses from future flood damages property owners need to protect themselves by investing in cost-effective mitigation measures.

5.2.3 Recommendations to insurance companies

- The South African Insurance Association, with government, must amend the insurance policies to adopt a holistic approach, including consideration of property flood insurance.
- The insurance industry must introduce the FASTER system. In England and Wales, the system has been shown to speed up claims handling, improve customer service, reduce claims handling costs, check for fraudulent claims, and capture data which could feed into building standards reviews and flood modelling.
- Long-term house loans must be tied up to a bond for mitigating a structure coupled with reduced insurance premiums
- National Government need to give insurers freedom to charge these rates subject to solvency regulations that prevent undercapitalized insurers from charging unduly low premiums with the intent of declaring bankruptcy should a flood disaster occur.

5.3 CONCLUSION

It is evident that flood risk has an adverse impact on insurance in the GLM; hence more amounts were paid out in the municipality. The flood impact on insurance, of each of the identified sectors is different. The GLM experiences high rainfall in winter and sometimes floods in the same season, resulting in more flood damage. The images showed how badly floods affect the area. Current policies that govern flood risks are failing to reduce the impact of floods on the community and the insurance industry in South Africa. Methodologies to improve flood risk identification are important to reduce flood insurance claims in the area.

The international communities have measures and strategies to reduce flood impact. The development of floodplains may result in flood damage, and insurance companies paying out more claims. If not, then the government carries the responsibility for flood relief funds. Municipal by-laws that discourage development in the 1:50 year flood line must be enforced by the local councils and police services, like in other developed countries. Overall, it is concluded that the GLM and the insurance industry are affected negatively by flood loss and damages. In light of all the findings that the researcher has made, this study calls for a continuous flood risk assessment, globally, to reduce the impact of flood risks on the insurance companies.

BIBLIOGRAPHY

Association of British Insurers, 2005. Making communities sustainable: managing flood risks in the government's growth areas. February summary report. *Association of British Insurers, London Administration Review,* 54: 229–238.

Alexander, D. 2002. Principles of emergency planning and management. Harpenden: Terra Publishing.

Alexander, J. 1993. Impacts of floods on agriculture in Southern Africa. Pretoria: UNISA.

Alexandra, W.J.R. 2000. Flood risk reduction measures. Pretoria: University of Pretoria.

Amrhein, C.J. Husset, D.P. & Quary, C.O. 1996. Personal Insurance. London: Routledge and company.

Anderson, D.R. 2002. Environmental risk management - a critical part of corporate strategy. In the Geneva papers on Risk and Insurance, Geneva: Chartered Property Casualty Underwriters. *Journal, summer*, 76-89.

Anderson, C.V. 2002. The FEMA. New York: Nova Science publishers.

Anderson, D.R. 1974. The national flood insurance programme - problem and potential. *Journal of risk and insurance*. Lynne Rienner Publishers 41: 579-600
.

Anderson, M.B. & Woodrow, P. J. 1998. Rising from the ashes: Development strategies in times of disaster. Boulder: Lynne Rienner Publishers.

Arup, 2006. North East yorkshine strategic flood risk assessment. Final report for Rydale Council Scarborough borough council and New York. Leeds: Moors National Park Authority, Ove Arup & partners Ltd.

Associated Press. 2006. Associated press news. [Online].
http://www.msnbc.msn.com/id/14154793/ [15 July 2007].

Athearn, L.J., Pritchett, S.T. & Schmit, J.T. 1989. Risk and Insurance. 6th ed. St Paul: West publishing Company.

Barbie, E. & Mouton, J. 2001. The practice of social research. South Africa: Oxford University Press.

Basson, L. Personal communication. [12 September 2007]. Employee of George Local Municipality.

Baulware, G.W. 2009. Public policy evaluation of the national flood insurance programe. Florida: University of Florida.

Becker, A. & Grunewald, U. 2003. Disaster management – flood risk in Europe. *Science 300*. Cambridge, Harvard University. 5622: 1099-1099.

Bekker, S. 2004. Personal communication on flood insurance and damage. [Online]. Available: http://www.GeorgeLocalMunicipality.org.za/idp2004/index.html [1 March 2011].

Benson, M.N. 2005. Thoughts on the designs of floods and drought. 2nd ed. Fort Collins, Colorado: Hydrology water publication.

Best Company. 2008. Flood insurance Resources. New Jersey: AM Best Company Inc.

Black, C.G. 2005. Subsiding disaster: national centre analysis. University of Dundee: Halifax General Insurance Services.

Browne, M.J. 2000. The demand for flood insurance: empirical evidence facility of risk management and insurance. New York. American economic review. *Journal of risk and uncertainty*, 203: 291-306.

Browne, M.J. & Hoyt, R.E. 2000. The demand for flood insurance: empirical evidence. *Journal of risk and uncertainty*. New York. American economic rewiew. 20: 291–306.

Burby, R.J. 2001. Flood insurance and floodplain management: the US experience. *Environmental hazards*. Chapel Hill.University of North Carolina. 3: 111-122.

Burby, R.J. & Dalton, L. 1994. Plan can matter! The role of land use plans and state planning mandates in limiting the development of hazardous areas. *Public Administration Review*. Chapel Hill.University of North Carolina. 54: 229-38.

Carstens, S. 2008 Personal communication. [04 September2008]. Chief Town Planner: George Local Municipality, George

Clark, M.J. 1998. Flood insurance as a management strategy for UK coastal resilience. *Geographical Journal 164(3)*: Southampton, University of Southampton. 333-343.

Congressional Budget Office. 2007. Cost estimate: flood insurance. Reform and Modernization Act of 2007.

Collin, R., Thorne, E.P., Penning-Rowsell, E.C. 2007. Future flooding and coastal erosion risks. Thomas Telford. London: Middlesex University Flood Hazard Research Centre

Cooke, R., M. & Kousky, C. 2009. Are catastrophes insurable? *Resources*, Resource for the future, Washington D C.172: 18-23.

Council for Geoscience. 2007. Sinkholes and Subsistences. Institute of engineering and environmental geologists. [Online]. http://www.geoscience.org.za/index.php?option=com_content&view=article&id=994%3Asinkholes-and-subsidences&catid=116%3Ageological-hazards&Itemid=434 [23 November 2011].

Cowling, R.M. & Hilton-Taylor. 1994. Patterns of plant diversity and endemisin in Southern Africa. (*In* Huntley, B.J. (ed). *Botanical Diversity in Southern Africa*. Strelitzia. National Botanical Institute, Pretoria. p. 31-52.).

Crichton, D. 2007. What can cities do to increase resilience? *Philosophical transactions of the royal society*. Royal society Publishing, London.10(1098): 1-11.

Crinchton, D. 2002. UK and global insurance responses to flood hazards. *Water international*. Royal society Publishing. DHI, Inc, Atlanta London.27: 119-131.

Crowell, M., Hirsh, E. & Hayes, T. 2007. Improving FEMA's coastal risk assessment through the NFIP: a historical overview. *Marine technology society journal*. DHI, Inc, Atlanta.1: 5-14.

Disaster Mitigation for Sustainable Livelihoods Programmes (DiMP) 2003. March 2003 Cut-off Low: Consolidated report. Rondebosch: University of Cape Town.

Dlugolecki, A. 2004. Climate change and the insurance industry: The Geneva Papers on Risk and Insurance. London: Association of British insurers.

Du Plessis, L.A. & Viljoen, M. F. 1999. Determining the benefits of flood mitigation measures in the lower Orange River: AGIS application. *Water SA*. University of Free State. Bloemfontein. 25:2.

Environmental Agency. 2004. The appraisal of human related intangible impacts of flooding: Technical report. London: EA/DEFRA.

Environmental Risk Management Authority. 1999. Identifying Risk: For Application under the Hazardous Substances and New Organisms Act 1996. New Zealand Public Sector: Standards Australia and Standards New Zealand.

Erickson, K.T. 1998. Trauma at buffalo creek. *Society*. Wiley, New York.2: 153-161.

FAO. 1992. Theo irrigation schemes and Compare African (Madagascar, Maroc, Niger, Senegel, Tunisie). Rome: FAO.

FAO. 2004. Drought impact mitigation and prevention in Limpopo river basin: A situation analysis land and water discussion. Paper 4. Rome: Food and agricultural organization in UK.

FEMA, 2002. Federal Insurance and Mitigation Division: The NFIP. Actuarial rate review. Washington DC. US: Government printing office.

Ferguson, C. 1996. Personal Insurance. Underwriting and Marketing Practice London: Alan Sutton.

Few, R., Ahern, M., Mathews, F. 2004. Floods, Health and Climate Change: A Strategic Review. Norwich, United Kingdom: University of East Anglia.

Financial Services Board. 2008. List of registered insurers. The FSB is an ISO 9001 certified Organization. Pretoria.

Freeman, P.K. & Kunreuther, K. 2002. Environmental risk management for developing countries. In the Geneva papers on Risk and Insurance, Issued and practice. Northampton, MA: Edward Elgar publishing.

French, W. 2002. Managing floodplain development through the national flood insurance programme. FEMA. Home study course IS-9: Flood plain management home study course.[online] www.floods.org. [12-March-2010].

Gavin, S., Reid, J. & Scott, M. 2005. Standards for the repair of building following flooding. London: CIRIA.

George Local Municipality. 2005. Economic Analysis. South Africa: George Local Municipality. Western Cape, South Africa: George Local Municipality.

George Local Municipality Herald. 2007. *The George Herald*. George.

George Local Municipality. 2005. Integrated Development Plan. Western Cape, South Africa: George Local Municipality.

Gibb, A. 1999. Environmental Impact Assessment for the Proposed Road Link between the Outeniqua Pass and National Road (N2). Earthscan Publications Ltd. Cape Town.

Gill, T. & Kruger, A.C. 2004. Assessment of changing MAP for 400 South Africa rainfall stations from 1911 to 2000. *Proceedings of the 9th International meeting on statistical climatology*, Johannesburg.

Gordis, P., 2000. Property and Casualty Insurance. 35th ed. London: The Rough Notes Company, Inc.

Gordon, N.D., McMahon, T.A., Finlayson, B.L., Gippel, C.J. & Nathan, R.J. 2004. Stream Hydrology: An introduction for Ecologists. 2nd ed. England: John Wiley and Sons.

Gouws, C.M. Reyneke, k. Tempelhoff, J. W. N. Van Eeden, E.S. Van Niekerk, D. and Wuriga, R. 2005. The floods of December 2004-January 2005 in the Garden Route region of the Southern Cape South Africa. Report for the Research Focus Area 7.2: North-West University. Vanderbnijlpark.

Grace, M.F. & Klein, R.W. 1999. An analysis of urban homeowners insurance markets in Texas, Center for Risk Management and Insurance Research, Atlanta. :Georgia State University.

Grace, M.F., Klein, R.L. & Kleindorfer, P.R. 2000. The demand for homeowner insurance with bundled catastrophe coverage. Paper presented at the second Euroconference on global change and catastrophes risk management. Austraia : Earthquake risk in Europe

Grisman, P.Y., Knight, R.W., Eaterling, D.R., Karl, T.R., Hegerl, G.C. & Razuvaer, V.N. 2005. Trends in the intense precipitation in the climate record. *Journal of climate,* 18: 1326-1350.

Gwata, M. 2007. Personal communication. [17 November 2009]. Meteorologist: South African Weather Services. Pretoria.

Haas, J.E., Kates, R.W. & Bowden, M.J. 1977. Reconstruction following disaster. Cambridge: MIT press.

Haddow, D., Jane. A. & Bullock, 2004. Introduction to emergency management. Amsterdam: Butterworth-Heinemann.

Hajat, S., Ebi, K.L. & Kovats, R.S. 2003. The human health consequences of flooding in Europe and the implications for public health: A Review of the Evidence. *Appl Environ Sci Public Health*, 1:13–21.

Hamilton, K.L. & Malecki, D.S. 1994. Personal insurance: property and liability. (Second Edition), American Institute for Chartered Property Casualty Underwriters: American Institute.

Harrington, E.S. & Niehaus, G.R. 1999. Risk management and insurance. Boston: Irwin McGraw-Hill.

Heller, L., Colosimo, E. A. & Antunes, C.M. 2003. Environmental sanitation conditions and health impact: a case-control study. *Rev Soc Bras Med Trop*, 36: 41–50.

Hitchcock, G. & Hughes, M.D. 1994. Research and the teacher: A qualitative introduction to school-based research. London: Routledge.

Hittleman, D.R. & Simon, A.R. 1997. Interpreting educational research: An introduction for consumers of research. 2nd ed. Englewood cliffs, New York: Prentice-Hall.

Hopkins, W.G. 2000. Quantitative research. New Zealand: Research institute for sport and exercise sciences.

Huber, M. 2003. Variation in the insurability of floods. Evidence for robust tropical dynamics in the "hothouse". *Science*, *299*, 877-881.

Huber, M. 2004. Insurability and regulatory reform: is the English flood insurance regime able to adapt to climate change. *The Geneva papers on risk and insurance*. 29: 169-82.

Hulme, M., Doherty, R., Ngara, T., New, M. & Lister, D. 2001. African climate change: 1900-2100. *Climate Research*, 17: 145-168.

Hulse, TJ. 1997. Fire origin and the cause for Insurance Professionals. Briantan, Maryland: University Press of America.

Hulse, T.J. 1997. Fire origins and cause for insurance professionals. Briantan, Maryland: University Press of America.

Hung-Chih Hung, 2009. The attitude towards flood insurance purchase when respondents' preferences are uncertain: a fuzzy approach. *Journal of Risk Research*, 12(2): 239–258.

Hung, H.C. & Hwang, H.Y. 2003. The attitude towards buying flood insurance: A case study for the residents along the middle and lower reaches of the Keelung River. *Journal of City and Planning,* 30: 241–58.

Hutchin, J.W. 2002. Environmental conservation and the risk industry: A natural alignment of interests. In The Geneva Papers on Risk and Insurance. Issues and practice. 27(2).

Huysamen, G.K. 2001. Methodology for the social and behavioural sciences. New York: Oxford University Press.

Intergovernmental Panel on Climate Change. 2001. Climate Change 2001: impacts, adaptation, and vulnerability. Cambridge, United Kingdom: Cambridge University Press.

Jansen Van Vuuren, G. Personal communication. [8 November, 2007].Storm water and Flood Management for City of Tshwane Metropolitan Municipality

Jones, C. 1996. Participatory rural appraisal. UK: Institute of development studies.

Knoetze, J. Personal Communication. [12 September 2007].Employee of George Local Municipality.

Kok, M. & Barendregt, A. 2004. Verantwoorddelikjkheid en aansprанklijkheid by wateroverlastschade. Directoraat generaal water. HKV Liijn in water.

Krauss, G.W. 1997. Homeowners analysis. Munich: London. The Rough Notes Company, Inc.

Krug, E., Kresnow, M.J. & Peddicord, 1998. Suicide rates up after natural disasters. *New England Journal of medicine*: 373-378.

Kunreuther, H. 1978. Disaster insurance protection paying the price: the status and role of insurance against natural disasters in the United States. New York: Joseph Henry press.

Kunreuther, H.C. & Michel-Kerjan, E.O. 2006. Climate change and insurability of large-scale disasters and the emergency liability challenges: working paper 12821. Cambridge MA: NBER working paper series.

Lamb, H. 1991. Historic storms of the North Sea, British Isles and Northwest Europe. Cambridge: University of Cambridge Press.

Land Religion and Development Research. 2006. Capacity assessment report on municipal functions. Western Cape: University of Cape Town.

Leedy, P.D. & Ormrod, J.E. 2001. Practical research planning and design. 7th ed. New Jersey: Merril Prentice Hall.

Lourens, P. 2007. Flood damages set at R630-million in George Herald. George Herald Newspaper. George. Dec.13. p-7.

Lucas, L., Mclean, J. & Green, P. 1996. Practical guides: Reinsurance management. New York: LLP Inc.

Lynch ,S.D., Zulu, J.T., King, K.N. & Knoesen, D. 2001. The analysis of 74 years of records by the Irwins on two farms south of Potchefstroom. *Water SA*, 27: 4.

Mason, S.J., Waylen, P.R., Mimmack, G.J.M., Rajaratnam, B. & Harrison, J.M. 1999. Changes in extreme rainfall events in South Africa. *Climatic change,* 41:249-259.

Maynard, T. 2008. Impact on Insurance and how it can help with adoption with mitigation: emerging risk. London: Lloyd's exposure management.

McBride, C. 2001. Meteorological Observations and Instrument. Flood hazard pricing and insurance premium differentials: evidence from the housing market. *Journal of Risk and Insurance 57(4)*: 654-663.

McCann, Janice, & Shand, B. 1995. Surviving natural disasters: how to prepare for earthquakes, hurricanes, tornados, floods, wildfires, thunderstorms, blizzards, tsunamis, volcanic eruptions, and other calamities. Salem: Dimi Press.

McMillan, J.H. & Schumacher, S. 1993. Research in education: a conceptual introduction. 3rd ed. New York: Harper Collins.

Meier, K.J. 1988. The political economy of regulation. The case of insurance. New York. Blackwell science.

Michel–Kerjan, E. & Kousky, C. 2010. Come rain or shine: evidence of flood insurance purchases in Florida. *Journal of risk and insurance*, Forthcoming.

Mileti, D.S. 1999. Disasters by design: A reassessment of natural hazards in the United States. Washington DC: Joseph Henry Press.

Montz, E. & Tubin, G. 1998. Natural hazards, explanation and integration. New York: Guilford Press.

Mooiman, L. Personal communication. [12 September 2007]. Employee of George Local Municipality.

Mothata, M.S. 2000. The provision of education to minorities with special emphasis on South Africa. Pretoria: UNISA. (DEd-thesis.)

Mouton, J. 2001. How to succeed in your master's & doctoral studies. Pretoria: Van Schaik Publishers.

Munich Re. 2003. Claims management following natural catastrophes: experience, analysis, action plans. Munich: Munich Re reinsurance group.

National Water Resource strategy. 2002. Department of water affairs and forestry. Pretoria. Government printers.

National Weather Services. 2005. Flood hazards office of climate, water and services. East west highway. Silver Spring.

Ndlovu, S. 2007. Living with flood risk: A case study of the Dambakurima area of Muzarabani District in Zimbabwe. Bloemfontein: University of the Free State.

News24. 2003. *Flood impacts.* [Online]. http://www.news24.com/News24/South_Africa/News/0,6119,2-7-1442_1338244,00.html. [8 January 2008].

NM State University. 2005. *Environmental health and safety: Laboratory safety guide*. [Online]. www.nmsu.edu/~safety/programs/lab_safety/app15_msds_gloss.htm. [31 July 2007].

Njoh, A. J. 2006. African cities and regional trade in historical perspective: implications for contemporary globalisation trends in Cities. *20(3*):18-29.

Palm, R.I., Hodgson, M.E., Blanchard, R.D. & Lyons, D.I. 1990. Earthquake Insurance in California: Environmental Policy and Individual Decision-Making. Boulder, Colorado: Westview Press.

Parker, J. & Neal, J. 1999. Evaluation of the performance of flood warning systems. 13: 7-157.

Parklina, N. 2003. Flood Insurance. Europe: Organization for Economic Cooperation and Development.

Pasterick, 1998. Paying the price: The status and role of insurance against national disasters in the United States. (*In* Kunreuther, H. & Roth, R. (eds.), *The NFIP.* Washington DC: Joseph Henry press. 125-154.

Penning-Rowsell, E.C. & Chatterton, J.B. 1997. The Benefit of flood alleviation: a manual of assessment techniques (the blue manual). Aldershot: Gower Publishing.

Penning-Rowsell, E., Chatterton, J., Wilson, T. & Potter, E. 2002. Autumn 2000 floods in England and Wales: assessment of national economic and financial losses. London: Middlesex University Flood Hazard Research Centre.

Penning-Rowsell, E.C., Green, C.H., Thompson, P.M., Coker, A.C., Tunstall, S.M., Richards, C. & Parker, D.J. 1992. The Economics of coastal management: a manual of benefit assessment techniques (the yellow manual). London: Belbovenl Wileys.

Penning-Rowsell, E.C., Johnson, C., Tunstall, S.M., Tapsell, S., Morris, J., Chatterton, J. & Green, C. 2005. The benefits of flood and coastal risk management: a manual of assessment techniques. London: Middlesex University Press.

Polit, D. & Hungler, B.P. 1983. Nursing Research. Toronto: Lippincott Company.

Pollner, J.D. 2001. Catastrophic risk management: using alternative risk financing and insurance pooling mechanisms. Latin America and the Caribbean region: World Bank.

Rejda, G.E., Luthardt, C.M., Ferguson, C.L & Donald, R. 1997. Personal insurance. 3rd ed. USA: American Institute for Chartered Property Casualty Underwriters.

Queensland Government, 2002. Disaster loss assessment guidelines, Illycroft (Pty) Ltd: Queensland, Australia.

REPUBLIC OF SOUTH AFRICA. Department of cooperative governance and traditional affairs. 2011. *Government flood damage speech*. Pretoria: Government printers.

REPUBLIC OF SOUTH AFRICA. Department of statistics South Africa. 2001. *Census*. Pretoria: Government printers.

REPUBLIC OF SOUTH AFRICA. Department of water affairs and forestry..2002. *National water resource strategy.* Pretoria: Government printers.

REPUBLIC OF SOUTH AFRICA. 1977. *The National Building Regulations and Building Standard Act, No103 of 1977*. Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. 1996. *The Constitution of the Republic of South Africa, No 108 of 1996*. Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. 1998. *The Short-term Insurance Act, No 53 of 1998*. Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. 1998. *The White Paper on Disaster Risk Management, Notice 23 of 1998.* Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. 2000. *The Local Government Municipal System Act, No 32 of 2000*. Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. 2002*. The National Disaster Risk Management Act, No 57 of 2002*. Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. 2004. *The National Disaster Risk Management Framework of 2004*. Pretoria: Government Printers.

REPUBLIC OF SOUTH AFRICA. 1998. *The National Water Act, No 36 of 1998*. Pretoria: Government Printers.

Roaf, S., Crichton, D. & Nicol, F. 2005. Adopting buildings and cities for climate change. Oxford: Architectural Press.

Salveson, D. 2005. The Coastal Resources Act: has it discouraged coastal development. *Coastal management*, 33: 181-195.

Sanders, R., Shaw, F., Mackay, H., Galy, H. & Foote, M. 2005. National flood modelling for insurance purposes: using the IFSAR for flood risk estimation in Europe. *Hydrology and earth system science*, 9(4): 449-456.

Sax, G. 1979. Foundations of educational research. Englewood cliffs, New York: Prentice-hall.

Scawhorn, C. & Kobayashi, K. 2008. Asian catastrophe. Insurance. Flagstone Re. London: Risk bools.

Schultze, E.P., Smith, I. & Granam, S. 2001. Flood and risk assessment in southern Africa. Pretoria. IASP Press.

Scott, K. Personal communication. [10 July, 2008]. Agriculturist. ARC

Scott, P.A., Jones, G.S. & Mitchell, 2003. Do models underestimate the solar condition to recent climate change? *Journal of climate,* 16(24): 4079-4093.

Shabman, L. 2009. A new approach to reforming the natural flood insurance program: RFF weekly policy commentary.

Smith, D.I. & Greenaway, M.A. 1993. An introduction to urban flood damage assessment. Johannesburg: Paper presented to the Department of water affairs.

South African Insurance Association. 2007. South African insurance data. SAIA: Johannesburg.

South African Weather Services. 2011. [Online]. Available: (http://www.weathersa.co.za. [30 March 2011].

Southern Africa Humanitarian Crisis. 2007. [Online]. http://wwww.reliefweb.int/rw/rwb.nsf/doc116?OpenForm&rc=1&emid=ACOS-635PKL&secid=1. [15 September 2007].

Stevenson, R. 2003. Ensure axes insurance for property at risk of flooding. *Money marketing,* 14.

Storie,M, 2011. Methodology. Email communication. Johannesburg.

Strauss, 1993. The potential role of the school as community centre. Pretoria: UNISA. (MED Dissertation.)

Swiegers, C. Personal communication. [27 May, 2007].Chief Engineer in the Department of Water Affairs and Forestry

SwissRe. 1998. Floods - an insurable risk. Zurich: Swiss Reinsurance Company.

TAIWAIN. National Fire Agency. 2007. *Natural disaster loss statistics*. Taipei: Government Printers.

Takeuchi, K. 2002. Flood management in Japan - from rivers to basins. *Water international*, 27:20-26.

Tavendale, A. & Black, A.R. 2003. Planning practice under NP PG7: planning and flooding. *Scottish planning and environment law*, 95:11-13.

Thampapillai, D.J. & Musgrave, W.F. 1985. Flood damage mitigation: a review of structural and non-structural measures and alternative decision frameworks. *Water resources,* 4: 411-424.

The National Academy of Sciences National Research Council, 1985. Alluvial fan flooding. Washington DC: National academy press.

Thompson, L. 2008. Report on rainfall and flood events in the George area of the Southern Cape. George Local Municipality. George

Thorne, C., Evans, E., Edmund C. & Penning-Rowsell, E. 2007. Future flooding and coastal erosion risks. Aldershot: Gower Publishing.

Tobin, G. & Ollenburger, J.C. 1996. Prediction levels of post disaster stress in adults following the 1993 floods in the upper Midwest. *Environmental and behaviour*. 28: 340-357.

Tol, R.S.J. 2001. Estimate of damage cost of climate change, part 1: benchmark estimates. *Environmental and resources economics*, 21(1): 47-73.

Tubin, G. & Montz, E. 1994. The flood hazard and dynamics of the urban residential land market. *Water resources bulletin*, 30(4): 673-685.

Unit for Religion and Development Research (URDR). 2006. Socio-economic survey for George Municipality. Stellenbosch: University of Stellenbosch.

United Nations for Development Programme. 1992. An overview of Disaster Management. 2nd ed. UN:UNDRO.

United Nations Office for the Coordination of Humanitarian Affairs (OCHA). 2007. Rapid environmental Assessment: Cyclones and Flooding in Madagascar. United Nations.

United Nations World Food Programme (UNWFP). 2007. WFP's Operational Requirements, shortfalls and Priorities. United Nations.

UNITED STATES OF AMERICA. 1973*. Flood Disaster Protection act of 1973*. (PL 93-235). Washington DC: US Government Printing Office.

UNITED STATES OF AMERICA. Federal Emergency Management Agency. 2002. Federal Insurance and Mitigation Division: The NFIP. *Actuarial rate review*. Washington DC: US Government Printing Office.

UNITED STATES OF AMERICA. Federal Emergency Management Agency. 2006. *Guidelines and Specifications for Flood Hazard Mapping Partners*. Appendix D: Guidance for Coastal Flooding Analyses and Mapping. Washington DC: US Government Printing Office.

UNITED STATES OF AMERICA. Federal Emergency Management Agency. 2007. *Flood Damage Reduction Strategies and Tools.* Washington DC: US Government Printing Office.

UNITED STATES OF AMERICA. GAO. 2008. *Flood insurance: Information on financial aspects of the NFIP*. Washington DC: US Government Printing Office.

UNITED STATES OF AMERICA. Department of Homeland Security. 2007. *Flood Damage Reduction Strategies and Tools*. Washington DC: US Government Printing Office.

UNITED STATES OF AMERICA. *The Water Framework Directive.* 2000. Washington DC: US Government Printing Office.

Usman, M.T.E., Archer, P., Johnson, & Tadross. 2005. A conceptual framework for enhancing the utility of rainfall hazards forecast for agriculture in mainland environments. *Natural hazards*, 34: 111-629.

Valsamakis, A.C., Vivian, R.W. & Du Toit, G.S. 2005. The theory and principles of risk management. Isando, SA: Heinemann publishes, Ltd.

Van Dijk, M. & Alexandra, W.J.R. 2001. UPFLOOD flood analysis programs. Operators manual: Department of civil engineering. Pretoria: University of Pretoria.

Van Niekerk, D. 2009. The effects of climate change in two flood laden and drought stricken areas in South Africa: Responses to climate change – past, present and future: South African National Disaster Management Centre. Potchefstroom.

Van Wageningen, A. & Du Plessis, J.A. 2006. Are rainfall intensities changing, could climate change be blamed and what could be the impact for hydrologists? Stellenbosh: University of Stellenbosch.

Vaughan, E.J. & Vaughan, T.E. 2001. Essential risk management and insurance. 2nd ed. New York: John Wiley & Sons, Inc.

Wallingford, H.R. 2002. Catchments flood management plains - Development of a modeling and decision support framework. Report Ex4495 to Defra/Environment Agency. Project number W5f (01)01.HR Wallingford.

Watson, L. J. 1997. Personal Insurance: Service and Management. Mavery: Insurance institute of America.

Watson, L. & Lilly, C. 1997. Personal Insurance: Mavery: Insurance institute of America.

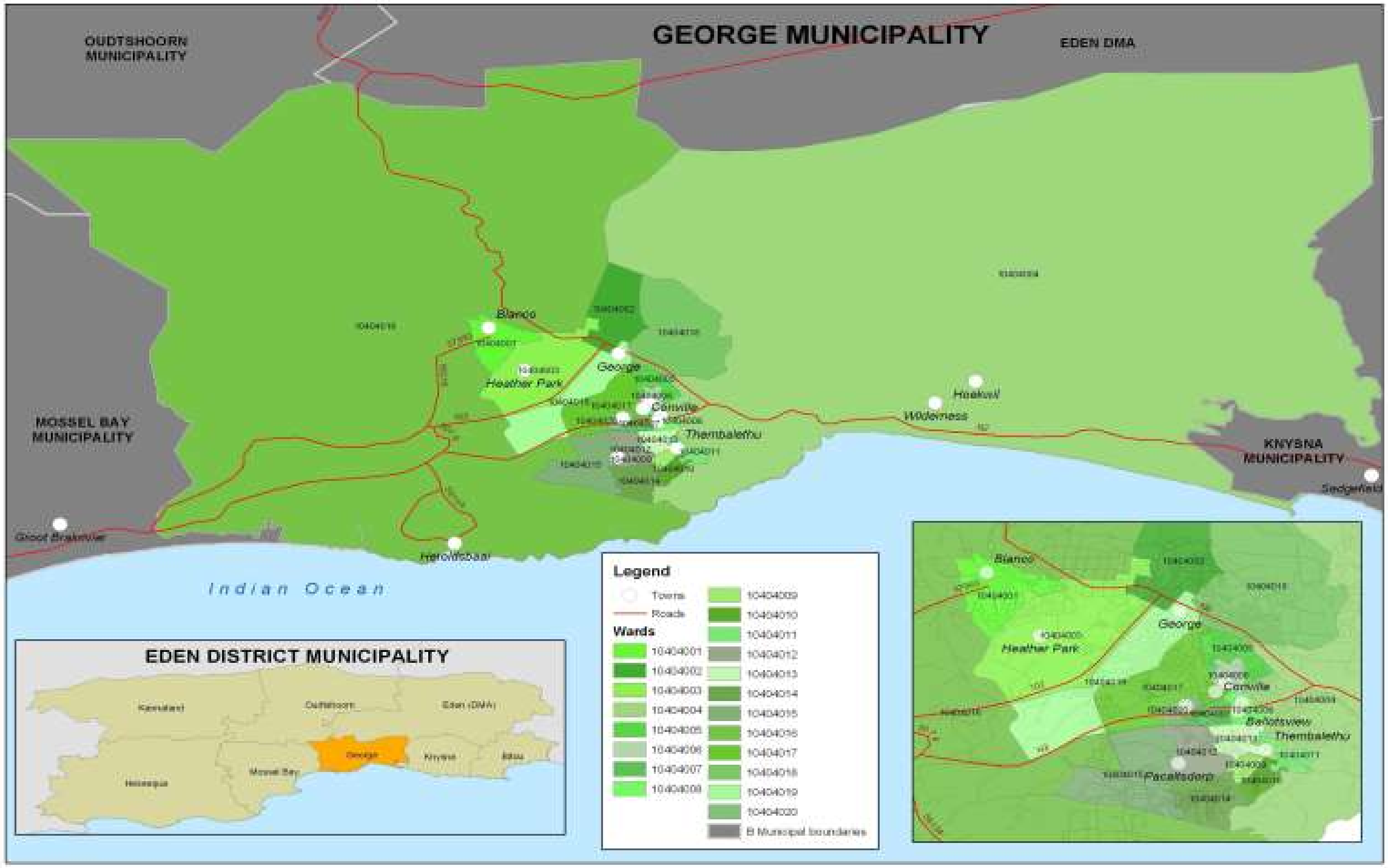
Western, K. 1982. Epidemiologic Surveillance after Natural Disasters. Washington DC: Pan American Health Organization.

Western Cape Province, 2008. A climate change strategy and action plan for the Western Cape: Department of Environmental Affairs and Development Planning. Cape Town.

White, I. & Richards, J. 2007. Planning policy and flood risk: the translation of natural suicidance into local policy. Routledge, *Taylor and Francis group*. 22: 513-534.

Wisner, B., Blacke, P., Cannon, T. & Davis, I. 2006. At risk: Natural hazards, people's vulnerability and disasters. New York: Routledge.

Annexure A



Map indicating George Local Municipality (McBride, 2001).

Annexure B

Questionnaire	UNIVERSITY OF THE FREE STATE UNIVERSITEIT VAN DIE VRYSTAAT YUNIVESITHI YA FREISTATA **Disaster Management Training and Education Centre for Africa (DiMTEC)** *Faculty of Natural and Agricultural Sciences*	UNIVERSITY OF THE FREE STATE UNIVERSITEIT VAN DIE VRYSTAAT YUNIVESITHI YA FREISTATA UFS UV

Questionnaire to municipal workers in the George Local Municipality

The objective of this questionnaire is to determine which services are mainly affected by floods in the George Local Municipality. It will focus on all properties in George especially the ones that are insured. The data obtained will be analysed and will form part of the mini dissertation on "*Flood risk and their impact on insurance: George Local Municipality*", supervised by Mrs. Maryna Strydom of the University of the Witwatersrand. Your time and assistance will be greatly appreciated.

Study leader: Maryna Storie
Maryna.storie@wits.ac.za
Student: Kgafane Matebane
2005175613@ufs.ac.za

1. Area of expertise: Tick the appropriate box

Hydrologists	
Infrastructural and town engineers	
SAIA representatives	
Meteorologists	

2. Which weather related hazard poses a major threat to property and livelihoods in the George Local Municipality?

Hazard
Floods
Fires
Drought/Famine
Windstorm
Hazardous material (explosive, flammable liquid, flammable entrapment gas, flammable solid,

oxidizer, poison, radiological, corrosive) pill or release

3. What are the major challenges for your sector in the GLM with regards to flood risks and their impact on Insurance [please complete table]

Challenge	Possible Solutions

4. Which services are mostly affected by floods in the GLM?
[Indicate by entering 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, to indicate from most likely (1) to least likely (highest number) in order of priority]

Services	
Agriculture (cropping & livestock)	
Shelter and non-food items	
Coordination and support services	
Food	
Infrastructure and Rehabilitation	
Protection/human rights/ rule of law	
Information security	
water and sanitation	
Education	
Health	
Fish farming	
Other: specify	

Thank you for your time.

Annexure C

A list of insurers who insure the George Local Municipality.

NAME OF THE INSURERS IN THE GLM
AA MUTUAL INSURANCE ASSOCIATION LIMITED IN LIQUIDATION
ABSA INSURANCE COMPANY LIMITED
ABSA INSURANCE RISK MANAGEMENT SERVICES LIMITED
ACE INSURANCE LIMITED
AEGIS INSURANCE COMPANY LIMITED
AIG SOUTH AFRICA LIMITED
AIM INSURANCE LIMITED
CENTRAL REINSURANCE CORPORATION LIMITED
CENTRIQ INSURANCE COMPANY LIMITED
CGU INSURANCE LIMITED
COMPASS INSURANCE COMPANY LIMITED
CONSTANTIA INSURANCE COMPANY LIMITED
DIAL DIRECT INSURANCE LIMITED
EMERALD INSURANCE COMPANY LIMITED
ENPET AFRICA INSURANCE LIMITED
ESCAP LIMITED
FERROSURE (SOUTH AFRICA) INSURANCE COMPANY LIMITED
FIDELITY INSURANCE LIMITED
FNB CREDIT GUARANTEE LIMITED
GENERAL ACCIDENT INSURANCE COMPANY SOUTH AFRICA LIMITED
GLOBAL INSURANCE COMPANY LIMITED
GUARDIAN NATIONAL INSURANCE COMPANY LIMITED
HOLLARD INSURANCE COMPANY LIMITED,THE
IMPERIAL REINSURANCE COMPANY LIMITED
INDEQUITY SPECIALISED INSURANCE LIMITED
INFINITI INSURANCE LIMITED
LION OF AFRICA INSURANCE COMPANY LIMITED
MOMENTUM SHORT-TERM INSURANCE COMPANY LIMITED
MONARCH INSURANCE COMPANY LIMITED
MUA INSURANCE COMPANY LIMITED
MUTUAL & FEDERAL INSURANCE COMPANY LIMITED
MUTUAL & FEDERAL RISK FINANCING LIMITED
NEDCOR (SA) INSURANCE COMPANY LIMITED
NEDGROUP INSURANCE COMPANY LIMITED
NEW NATIONAL ASSURANCE COMPANY LIMITED
NOVA RISK PARTNERS LIMITED
OUTSURANCE INSURANCE COMPANY LIMITED
REGENT INSURANCE COMPANY LIMITED
RELYANT INSURANCE COMPANY LIMITED

RENASA INSURANCE COMPANY LIMITED
RESOLUTION INSURANCE COMPANY LIMITED
SAGE SPECIALISED INSURANCES LIMITED
SAHL INSURANCE COMPANY LIMITED
SANTAM BEPERK
SASRIA LIMITED
SAXUM INSURANCE LIMITED
SOUTH AFRICAN RESERVE BANK CAPTIVE INSURANCE COMPANY LIMITED
WESTCHESTER INSURANCE COMPANY (PTY) LIMITED
WESTERN NATIONAL INSURANCE COMPANY LIMITED
ZURICH INSURANCE COMPANY SOUTH AFRICA LIMITED
ZURICH RISK FINANCING SA LIMITED

Source: Adapted from Financial Services Board, (2008).