Governing Coastal Risk:

The Case of Langebaan's Disappearing Shoreline

By

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Abstract

The coastal zone is the dynamic interface between land and sea and is under immense threat from increasing coastal population and development trends as well as global climate change. Given global and regional sea level rise projections, coastal African countries including South African are highly exposed to climate risks, namely storm surges, flooding and coastal erosion, which particularly impact socio-ecological systems at the local level. The aim of this study is to examine the various technical responses and governance approaches employed by government to address coastal risk along the Langebaan shoreline – a coastal town located in the Western Cape, renowned for its tourism, recreation and scenic attributes. However, the Langebaan shoreline is increasingly at-risk from climate-related sea level rise, compounded by inappropriate coastal development. This research suggests measures to strengthen coastal risk governance (CRG) through exploring stakeholder interpretation of coastal risk as well as understanding the barriers to addressing coastal risk in the context of the Saldanha Bay Municipality (SBM). This study was informed by a review of the legal framework governing coastal risk in South Africa as well as the various technical reports pertaining to addressing coastal erosion in Langebaan. Primary data collection was undertaken through semi-structured interviews. The findings suggest that coastal erosion along the Langebaan shoreline is a complex and multi-faceted human-environmental issue. Furthermore, various reactive steps have been taken in response to Langebaan's eroding shoreline since the 1997 storm, these included hard and soft engineering measures as well as managed retreat. However, the Saldanha Bay Municipality (SBM) remain crippled by lack of institutional capacity and resources to tackle environmental issues like coastal erosion. Therefore, strengthening coastal risk governance (CRG) in under-resourced municipalities like the Saldanha Bay Municipality (SBM) requires improved communication and coordination across all levels of government and with civil society, which in turn will promote long-term strategic thinking and innovative and collective action.

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Chapter 1

Introduction

The coastal zone is a unique, dynamic, resource-rich and interactive interface between land and sea. Coastal ecosystems are among the most diverse and highly productive biological systems on earth and support a range of socio-economic and cultural activities. Half of the global population resides within 100km of the ocean as twenty-one of the thirty-three megacities and 41-45% of global economic activity takes place in this zone (Glavovic et al., 2015; Ramesh et al., 2015; Newton & Weichselgartner, 2013). At the same time, the coastal zone is under immense pressure. The 21st century brings about new challenges that are impacting the coastal zone such as increased population pressure, inappropriate development and climate-induced change. Hence, in further understanding and responding to this complexity and uncertainty the use of combined and integrated systems thinking is required. Various scholars argue that given these contemporary challenges impacting the coastal zone, there is a growing need for solutions to these complex environmental problems to adopt interdisciplinary and holistic thinking in order to move beyond knowledge-specific boundaries and away from a 'one-size-fits-all' approach (Cheong, 2008; Bavinck et al., 2005; Turner et al. 1996).

Coastal risk is regarded as the possibility that a negative outcome will occur as a result of natural processes and or human activities and impact on the coastal zone (Cardona, 2004). According to the Intergovernmental Panel on Climate Change (IPCC) 2014, climate change is expected to affect coastal communities globally with many of these changes being attributed to sea level rise (SLR). Over the past decade there has been a 3.3mm increase in SLR per year with the observed changes in mean annual temperature expected to increase, contributing to rising sea levels (Davis-Reddy & Vincent, 2017). Goshen (2011) notes that the warmer the ocean, the more energy available to fuel a storm, therefore with a rise in sea temperatures, there will be an increase in the frequency and strength of storms at sea. These changes will exacerbate wave intensity, thus altering beach contours and accelerating coastal erosion (Kelly, 2015). The impacts of accelerated coastal erosion, in turn, will result in loss of property, commercial development and recreational activities as well as greater exposure to flood risk and potential loss of lives (Glavovic, 2015).

The human factor is a major driver of climate risk in the coastal zone. High population density, inappropriate coastal urban development, poorly sited industrial development, high levels of tourism and governance failures are some of the major human drivers fuelling coastal vulnerability. These factors and failures are exacerbated by climate change and compound existing problems and will most

likely create new risk (Newton &Weichselgartner, 2013; Priyanto, 2010; Cooper & Mckenna, 2007; Duxbury & Dickinson, 2007).

In responding to climate and human-induced changes, Cardona (2004) argues that a holistic approach to understanding risk could guide decisions taken within a geographic area through assessing the nonlinear relations and dynamics of interacting systems (i.e. social, institutional and environmental). Climate induced risks and associated impacts are becoming more frequent, intense and costlier, hence innovative and systems-orientated approaches are needed to address and manage these impacts. Berkes (2017) outlines that the involvement of local stakeholders and use of different knowledges is necessary for problem solving. Strengthening local institutions and building cross-scale linkages and problem-solving networks are equally important when dealing with the uncertainty and change of complex human-environmental systems. At the same time, Glavovic (2015) argues that understanding the complexity of coastal issues through multidisciplinary and transdisciplinary approaches is central to the development and implementation of effective, context-specific responses. These new ways of thinking and approaches to problem-solving underpin effective governance.

1.1. Rationale

Climate change is a global phenomenon with devastating impacts at the local level. This is especially evident given the many pressures already facing the coastal environment. Furthermore, local government is not well equipped to respond to multifaceted pressures given poor governance. Therefore, it is required that governance actors work collaboratively in response to these pressures.

Climate change impacts pose a severe challenge to society. How these impacts are experienced at local level and how governance actors respond to them depend on the socio-ecological context and a variety of governance factors. As the frontier of climate-induced impacts, the coastal zone is subject to both human as well as climatic and oceanic pressures (IPCC, 2014; Newton & Weichselgartner, 2013). Research has shown that sea level rise is projected to increase due to temperatures expected to rise by 1.5. degrees Celsius above pre-industrial levels between 2030 and 2052 if warming continues at the current rate (IPCC, 2014).

The global rise in sea levels is expected to severely impact low-lying coastal countries in Africa (IPCC, 2014; Newton & Weichselgather, 2013). Increased population pressures in coastal environments and inappropriate coastal development adds to the severity of climate-related stress. Furthermore, climate and human-induced change increases disaster risk through contributing to the vulnerability of local communities as well as reducing their ability to cope with existing levels of risk (Mertz et al., 2009). Coastal communities in developing countries, many reside in countries that are located in Africa, are at high risk to climate change impacts such as sea level rise, storm surges and flooding which is further

exacerbated by human factors (ISDR, 2008). One of these coastal countries that will continue to face the adverse effects of climate and human-induced change is South Africa.

The South African coast is highly vulnerable to the adverse effects of climate-induced risks such as coastal flooding and erosion (Davis-Reddy & Vincent, 2017; SAIIA, 2015). In fact, 80% of South Africa's coast is highly developed and given its sandy shores, is largely susceptible to these impacts (Theron, 2008). At the same time, approximately one-third of the South African population resides within 100km from the coast as it is seen as a vital commercial and recreational development source (SAIIA, 2015; Wigley, 2011). Most certainty, climate-induced impacts add to an already stressed coastal system considering the scale and intensity of human activities taking place at the local scale.

Along the Western Cape coast, sea level has risen at a rate of approximately 1.87mm per year between 1959 to 2006 (Kelly, 2015). At the same time, the province is highly urbanized especially along its coastal areas (Midgeley et al., 2015). The concentration of human activity along the Western Cape coast is due to strong economic growth, particularly through coastal activities such as port development, manufacturing, fishing, tourism and recreation and residential development (DEAT, 2000). In order to gain a better understanding of the governance of coastal risk at the local level, this project focuses on examining how different local governance actors understand coastal risk and how these actors are responding to coastal erosion along the Langebaan coast which is located in the Saldanha Bay municipality area in the Western Cape.

The selection of Langebaan shoreline was influenced by a study conducted by Theron & Rossouw (2008) who identified the Saldanha Bay as one of the most vulnerable coastal areas in South Africa to climate-induced impacts, hence the first rationale of this research. Their study took a predominantly quantitative approach by using vulnerability indicators such as rate of erosion and wave action and intensity to determine coastal vulnerability. However, existing academic as well as grey literature suggest that very little to no reference to human-induced risks such as inappropriate coastal development is being highlighted as contributing to coastal risk (Flemming, 2015; Theron & Roussow, 2008; Krug, 1999)

The second rationale for undertaking this research is to better understand governance approaches in the face of climate and human-induced coastal risks along the Langebaan coast. Traditionally, government was seen as responsible for steering and solving societal problems (Armitage et al., 2009; Berkes, 2007). The conventional idea of governance is that it is viewed as a task solely undertaken by government who has ultimate decision-making power (Bavinck et al., 2005). This form of thinking has facilitated a "silo" approach to addressing issues of coastal governance given single sector focuses which hinder

collaborative engagement, resulting in tensions between top-down and bottom-up implementation efforts (Sowman & Wynberg, 2014).

Governance, on the other hand, which is a relatively new term, sees governing as the responsibility of many actors including government, the private sector, NGOS and civil society (Ziervogel et al., 2017; Glavovic, 2015; Biggs et al., 2012). Governance of environmental issues such as coastal risk emphasises the importance of vertical and horizontal interactions across different institutions and building trusting relationships between governance actors (Sowman et al., 2016; Pahl-Wostl, 2009; Berkes, 2007). According to Glavovic (2015) and Glavovic et al. (2014), at-risk coastal communities are required to build 'layers of resilience' to buffer waves of adversity as climate change magnifies disaster risk given the adverse effects of unsustainable coastal development. This is further constrained by lack of municipal resources and capacity to respond to these risks. Folke et al (2016) and Sowman & Wynberg (2014) argue that the "wickedness" of environmental issues cannot be solely understood and addressed by conventional scientific and technical approaches, but rather through holistic, intersectoral and interdisciplinary approaches that require multi-layered institutional engagement.

Multi-layered engagement requires respect for and integration of different knowledges as well as participation of different governance actors in problem recognition and problem solving (Glavovic, 2015). Apart from the compartmentalised relationship that continues to exist between state and non-state actors, the dominance of traditional technocratic and 'hard' engineering approaches to addressing coastal risks as a short-term solution, continues to be favoured. These current governance structures and institutional paradigms discourage long-term collaborative engagement which is required to addressing climate change and its associated risks, particularly at the local government level (Glavovic, 2015; Taylor et al., 2014; Pasquini et al., 2013). The local sphere of government is the closest to communities yet constrained by numerous barriers, most of which are institutionally-underpinned barriers (Pasquini et al., 2013). Indeed, Shackelton et al. (2015) states that tackling barriers enables improved governance responses to complex issues at the local government level. The limited academic literature which speaks to the governance of climate and human-induced coastal risk at the local government level in South Africa, thus provides a further motivation to conduct this research.

The coastal town of Langebaan, which is located in the Saldana Bay municipal area, is considered a major tourist hotspot. However, this area is highly exposed to the adverse effects of flooding and shoreline erosion given the presence of development close to the high-water mark as well as major industrial activity north of the town. Therefore, the use of this coastal town as a case study is ideal in illustrating the complexity of coastal risk as a human-environmental issue as well as exploring the various technical measures and governance approaches taken to address and reduce these multi-faceted coastal risks.

In light of the limited recognition given to coastal risk as a complex human-environmental issue and the sectoral and technical responses to tackling these problems, this research raises the question of what approaches to coastal risk governance would be most appropriate to respond to climate and human-induced coastal change at the local level?

1.2. Aim and Objectives

The aim of this study is to examine the various technical responses and governance approaches employed by government to address coastal risk along the Langebaan shoreline, in order to propose alternative approaches that recognize the complexity, socio-economic importance and vulnerability of this coastal zone.

Considering the ongoing coastal erosion experienced along the Langebaan shoreline since the 1997 storm and the need for the risk to be mitigated, four objectives guided this research:

1. Identify and explore stakeholder interpretations of coastal risk along the Langebaan shoreline;
2. Explore the various responses (i.e. engineering and institutional) to addressing coastal risk along the Langebaan shoreline;
3. Identify the barriers to effective governance of coastal risk in the Saldanha Bay Municipality (SBM); and
4. Suggest measures to strengthen coastal risk governance (CRG) in the context of the Saldanha Bay Municipal area.

Strengthening effective coastal governance through improving collaboration and stakeholder relationships in the face of climate and human-induced change is a profound challenge given the complex and multi-scale interactions involved (Glavovic et al., 2015; Ramesh et al., 2015; Newton & Weichselgartner, 2013; Pasquini et al., 2013; Cheong, 2008; Bavinck et al., 2005; Cilliers, 1998; Turner et al., 1996). Consequently, this thesis seeks to better understand current approaches to coastal risk governance as well as challenges and enablers to adopting a holistic, integrated and collaborative approach to coastal risk governance at the local level.

1.3. Ethical Considerations

In undertaking this research, ethical clearance was obtained from the University of Cape Town's Science Faculty Ethics Committee which allowed the researcher to conduct fieldwork.
Data collection involved semi-structured interviews with stakeholders involved in tackling the Langebaan shoreline erosion problem. These stakeholders ranged from government officials, to coastal

engineers and local residents. Prior to the interview, the purpose of the study was clearly explained and participants were informed that all information provided would be treated confidentially. Permission was sought to record the interviews and all participants involved in the face-to-face interviews signed consent forms. Recordings were used solely for transcribing interviews and data analysis purposes. Two participants agreed to provide input via email and their consent to use their information was also obtained. The interview questions were pre-prepared. Participants were informed that the information disseminated from this study would be used solely for academic purposes. The researcher has agreed to share the information gathered from this research with the Saldanha Bay Municipality.

1.4. Structure of the Dissertation

The first chapter provides an introduction to this research project by briefly contextualising coastal risk from an international, national and local context. It then outlines the research rationale relating to how coastal risk is experienced at the local level and how governance actors are responding to this risk. It also presents the research question, aim and objectives. The ethical considerations are also mentioned.

The second chapter critically reviews literature relating to the governance of coastal risk. The literature includes themes relating to the coastal zone as a complex socioecological system; coastal risk as relating to the concept of risk and disaster risk; the human dimension of coastal risk in terms of tourism and port expansion. Literature relating to the concept of governance is unpacked in relation to risk governance. The conventional and new approaches to responding to coastal risk are also be reviewed and presented in this chapter.

Chapter three outlines the research approach and methods employed. The research adopted a complex system thinking approach and a case study approach. The methods used were semi-structured interviews and a review of grey literature. The approach to data analysis as well as the research limitations and challenges are also outlined in this chapter.

Chapter four explores the various policy and legislative frameworks that govern coastal risk in South Africa. Major legislation relating to environmental and coastal management, disaster risk and climate change is reviewed and discussed. Local government policies, plans and programmes relevant to coastal risk in the Saldanha Bay Municipality are also fleshed out.

Chapter five provides a description of Langebaan as the selected case study as relating to coastal risk.

Chapter six presents the findings of the study based on the review of various technical documents and the semi-structured interviews. These findings are categorised into four overarching themes namely;

stakeholder interpretation of coastal risk; various responses to coastal risk along the Langebaan shoreline; barriers to effective governance of coastal risk as well as measures to strengthen governance in response to coastal risk in the context of the Saldanha Bay Municipality (SBM).

Chapter seven analyses and discusses key findings from this research. The discussion points are subcategorised into four sections which includes; coastal risk as a contextually complex issue, exploring the traditional responses used to addressing coastal risk along the Langebaan shoreline, various municipal barriers to effective governance of coastal risk and measures to strengthening coastal risk governance (CRG) in the context of the Saldanha Bay Municipality (SBM).

Chapter eight revisits the key findings gathered, provides recommendations in response to coastal risk governance (CRG) in the Saldanha Bay Municipality (SBM) and suggests potential ideas for future exploration within this research area.

Chapter 2

Literature Review

2.1. Introduction

This chapter critically reviews literature relating to the governance of coastal risk. The central theoretical theme which informs the selection of literature is based upon the argument made by Jentoft & Chuenpagdee (2009) that environmental problems are 'wicked' or complex problems which ought to be understood from a holistic and interdisciplinary perspective. In light of this complexity, literature relating to the coastal zone as a complex socioecological system is explored and the numerous factors that interact and influence change are highlighted. In understanding coastal risk, the concept of risk is unpacked. The human dimension of coastal risk is then fleshed out by examining the impact of tourism and port expansion on vulnerable coastal systems. Furthermore, the concept of governance is discussed in relation to risk governance. Literature relating to the conventional as well as new approaches to responding to coastal risk are also reviewed.

2.2. The Coastal Zone: A complex system

The coastal zone is a unique, dynamic, resource-rich and interactive interface where land meets sea. It is viewed as a centre for socio-economic and ecological activities and acts as the basis for sustainable development (Azuz-Adeath & Arancibia, 2018; Balica et al, 2012; Cicin-sain & Knecht, 1998; Sowman, 1993). In further defining the coastal zone Glavovic et al. (2015) defines the coast as a biologically productive system which provides a range of natural goods and services that sustain coastal ecosystems such as a natural defence against storms, mitigation against floods and providing erosion control. The biophysical nature of the coastal zone facilitates hydrogeological, biological, atmospheric and chemical processes in sustaining local marine processes which converges at this land-sea interface, thus making it an ecological hotspot (Balica et al., 2012). The coastal zone is also associated with human activities which is evident, given that large populations are located within this zone and increasing due to its favourability for leisure, recreation and tourism. Evidently, half of the global population resides within 100km of the ocean as twenty-one of the thirty-three megacities and 41-45% of global economic activity takes place in this zone (Glavovic et al., 2015; Ramesh et al., 2015; Newton & Weichselgartner, 2013). As highlighted by Martinez et al. (2007), this dynamic zone is also associated with commerce and economic development given the presence of port and industrial facilities. Another element associated with the coastal zone relates to the administrative and institutional processes which includes planning, management, regulation and decision-making in ensuring its sustainability. Cicin-sain & Knecht (1998) outlines these processes as being the relationships amongst residents, users, policy makers and scientist who influences behavior in relation to understanding the coastal environment.

Berkes (2015) argues that part of the complex and unpredictable nature of the coast, is the diverse interactions which exist through multiple institutional arrangement. At the same time, Adger et al (2005) is of the view that these complex institutional arrangements stem from various actors and their harbouring of diverse knowledges in planning and managing the coastal zone given its non-linear and unpredictability. It is evident that the coastal zone is of interest to numerous stakeholders, which, at the same time, provides greater insight into addressing the numerous compounded pressures being faced.

In theory, the literature makes reference of the coastal zone as a dynamic and complex system (Azuz-Adeath & Arancibia, 2018; Berkes, 2015; Ramesh et al., 2015; Balica et al., 2012; Martinez et al., 2007; Adger et al., 2005; Bavinck et al., 2005; Turner et al., 1996; Sowman, 1993). In unpacking complexity, the literature argues that complexity is based on a new way of thinking about the world, contrary to the Newtonian Science philosophy which viewed the world within a reductionist, rationalist and objective light (Morin, 2007; Nowotny, 2005; Berkes et al., 2003; Cilliers, 2000; Morin 1992). Complexity thinking moves beyond this traditional worldview and introduces the idea of holism which argues that a whole is greater than the sum of its parts (Cundill et al., 2005; Cilliers, 2001; Morin, 1992). In other words, in order to understand a system in its totality, one needs to understand it in relation to all its components which are connected and constantly interacting and changing. Bearing this in mind, Cilliers (2000) argues explicitly that complexity thinking provides the foundational framework for understanding socioecological contexts and their interactions. Considering the socioecological nature of the coastal zone, several scholars (Berkes, 2007; Folke, 2006; Walker et al., 2004; Cilliers, 2000) identify characteristics which are illustrative of this complex environment. According to the literature, complex systems consists of many components (i.e. social, political, economic and environmental) which interact in a rich, dynamic and nonlinear manner resulting in feedbacks resulting in small causes having large effects (Cilliers, 2008, 2001, 2000, 1998; Liu et al., 2008; Cundill et al., 2005). In addition, these systems are hierarchical in terms of scale and interaction which cut across scale and are interdependent and have the ability to self-organize at points of instability. The literature unpacks the idea of self-organization as being the ability of a complex system to change spontaneously in order to adapt to its new environment (Folke et al., 2016; Berkes, 2007; Morin, 2007; Folke et al., 2006; Berkes et al., 2003). Therefore, in theory, the idea of a complex system cannot be divorced from the coastal zone due to the dynamism and rich interactions which exist given global climate change.

2.3. Understanding Risk

Risk is a complex and discipline-specific concept. It is regarded as the possibility that an undesirable outcome with adverse effects will occur as a result of natural events or human interventions especially in vulnerable socio-ecological systems (Cardona, 2004). Risk, which is a function of a hazard, is defined in terms of its outcome. In understanding risk, one needs to unpack the concepts of

vulnerability, exposure and hazard. Vulnerability, which is a central concept in the climate change and disaster risk discourse, is defined as the degree to which a system (i.e. individual or community) is susceptible to and unable to cope with change and perturbations (Preston et al., 2011; van Asselt & Renn, 2011; Cannon, 2008; Fussel, 2007; Adger 2006, Eakins & Luers, 2006; Brooks, 2003; Adger & Kelly, 2000; Klein & Nicholls, 1999). It reflects the potential of a system to experience harm in response to external influences, pressures or hazards. The broader literature notes the conceptual complexity of vulnerability as being discipline and context specific (Spalding et al., 2014; Field et al., 2012; Mertz et al., 2009; Fussel, 2007; Jannsen & Ostrom, 2006; Smit & Wandel, 2006; Wisner et al., 2003; Turner et al., 2003).

A hazard is then defined as a potentially damaging physical event, phenomenon or human intervention which is characterized by its location, intensity, frequency and probability (Cordona et al., 2012; Romieu et al., 2010; Fussel, 2007). Oppenheimer et al (2014) argues that risk is strongly determined by the coping and adaptive capacities of societies and judged by taking into account the magnitude (i.e. harmful consequences on human mortality), frequency (i.e. the timing and instances whereby socioecological systems are highly exposed and susceptible) and intensity of the hazardous event. As illustrated in the literature, examples of natural hazards include tsunamis, earthquakes, floods and wave surges which are exacerbated by bad urban planning and population pressures (Spalding et al., 2014; Romieu et al., 2010; Thomalla et al., 2006). Exposure, on the other hand, refer to the degree of vulnerability to loss experienced by a system (Spalding et al., 2014; Eakins & Luers, 2006; Smit & Wandel, 2006). Cannon (2008) highlights the components that capture the extent of exposure to risks as being livelihood resilience, self-protection in terms of peoples' capabilities to cope and protect themselves from hazards and social protection as relating to the extent of government involvement in allowing protection against hazards. At the same time, the degree of exposure varies and is also dependent on geographical location given the number of hazardous events present that may occur within a particular area (Cardona et al., 2012; Cardona, 2004). Furthermore, the risk of a hazardous event occurring is neither predictive nor probabilistic but spontaneous.

Over time, various scholars have also illustrated the concept of risk in various ways such as Wisner et al (2003) who present risk as a combination of vulnerability (i.e. the potential for damage, destruction or disruption) with the probability level of loss to be expected from a hazard. Kohler et al. (2004) and Spalding et al. (2014) who present risk as a function of hazards (i.e. refer to a natural event which may affect a particular place and time and varies in intensity and severity) as well as the exposure (i.e. a system's susceptibility to experience harm) of people and their capabilities to manage risk and respond. Welle et al (2014) are of the view that a risk is a multi-casual phenomenon that does not only depend on the exposure of a system to natural hazards and climate change but also on the social conditions and capabilities (i.e. the lack of capacity to adapt) that can reduce impact, as shown in figure 1. Thus, climate

change per se is not a risk. However climatic changes and related risks interact with the evolving vulnerability and exposure of a system, thus determining the changing level of risk severity and frequency experienced (Oppenheimer et al., 2014). Other conceptualisations of risk include ideas presented in the International Risk Governance Council Framework (IRGC, 2017). In this framework, the contributing factors to the emergence of risk include high scientific uncertainty, lack of knowledge regarding potential impacts, risks from systematic impacts which stem from multiple interactions, changes in context (i.e. natural environment, social trends and or regulations) that may alter the nature, probability and magnitude of expected impacts, varying susceptibilities to risks and loss of safety margins (IRGC, 2017). Cardona (2004) argues that an holistic approach to understanding risk could guide decisions taken within a geographic area through assessing the nonlinear relations and dynamics of interacting systems (i.e. social, political and ecological) which would allow for improved management. Considering the various definitions of risk identified in the literature, in this research, risk is defined and illustrated according to the recent Intergovernmental Panel on Climate Change report (IPCC, 2014). This is illustrated and explained in figure 1 below.

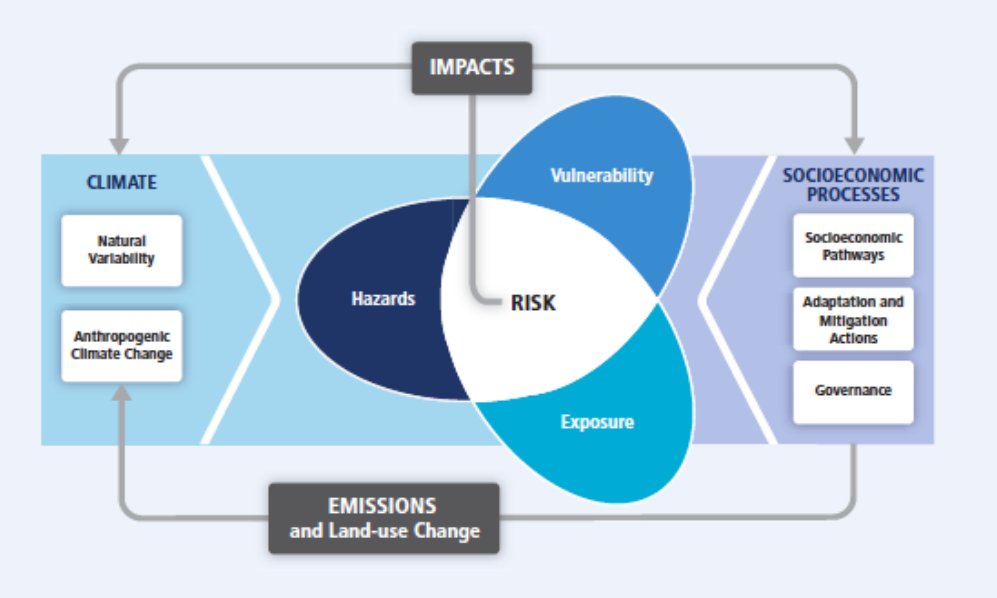

Figure 1: Multifaceted nature of climate risk (IPCC, 2014)

Climate Risk (CR) is defined as the risk(s) resulting from climate change and affecting both the natural and human system. Risk within the context of climate change is a dynamic and multidisciplinary concept which results from the complex interactions amongst natural, social, economic and institutional components as shown in figure 1 (IPCC, 2014). Climate change involves complex interactions given that the impacts of climate related risks result from the interactions of climate hazards (i.e. natural events such as flooding) with the vulnerability and exposure of the human-ecological system (IPCC, 2014). Changes in the climate and human system can either reduce or intensify risks arising from

climate change, therefore should be framed in relation to the local contextual social, economic and institutional realities (Davis-Reddy & Vincent, 2017).

According to the IPCC report (2014), climate change is expected to affect coastal communities globally with many of these changes being attributed to sea level rise (SLR). Global SLR is due to an increase in volume of the oceans caused by thermal expansion of the seas due to warming, melt-water entering the ocean from glaciers, ice caps and other ice at low altitude and melt-water from polar ice-sheets, especially from Greenland and West Antarctic (Goshen, 2011; Brooks et al., 2006).
One consequence of this warming is a global rise in sea level. Over the past decade there has been a 3.3mm increase in sea level rise (SLR) per year due to rising temperature which is expected to increase by 1.5. degrees Celsius above pre-industrial levels between 2030 and 2052 if warming continues at the current rate (IPCC, 2014).[1] Kelly (2015) notes that estimated SLR projections over the period 1980 to 1999 and 2090 to 2099 range between 0.18m and 0.59m. Goshen (2011) and Louw (2012) note that the warmer the water, the more energy the storm feeds-off, therefore with a rise in sea temperatures, there will be an increase in the frequency and strength of storms at sea, i.e. an increase in storminess.

SLR will be most severely felt at the local level. According to Kelly (2015) many areas will experience changes at the local scale that substantially differ from the global average. At the local scale, climate risks will intensify resulting in warmer oceans which will generate more frequent and violent storms and influence wave action affecting patterns of erosion, thus accelerating coastal erosion (Theron 2008; Brooks et al., 2006; Dolan & Walker, 2006). SLR will affect rainfall and temperature patterns which will increase flood risk. Other adverse consequences associated with climate change include the increase in flooding, the disruption of and or loss of sensitive coastal ecosystems such as mangroves and coral reefs, accelerated and even permanent coastal erosion and the submersion of land. Increased saltwater intrusion and raised groundwater tables, greater tidal influence and the increase in frequent climate and weather-related coastal disasters will also emerge as a result of climate risk (Glavovic, 2015; Wigley, 2011; Goshen, 2011; Klein et al., 1998).

2.4. Unpacking the Concept of Disaster Risk

Disaster risk refers to the product which stems from the interaction between a potential damaging event and vulnerable conditions of a system or element exposed (Cardona et al., 2012). The United Nations Development Programme describes disaster risk as the potential loss in lives, health, livelihoods, assets and services which could occur to a particular community or society over some specific future time period (UNDP, 2015). The IPCC defined disaster risk as linked to vulnerability and is determined as a

1 Considering the figures presented relating to projected climate-induced sea level rise, it should be noted that this research has been developed prior to the publishing of the latest IPCC report.

function of the character, magnitude and rate of climate variation and change to which the system is exposed to (i.e. an area that commonly experiences climate change and associated hazards), together with its sensitivity (i.e. how a system fares when exposed to an impact) and adaptive capacity (i.e. how a system is able to adapt or cope with an impact) (IPCC, 2012).

Climate change and disaster risk ought to be understood within a cultural, economic, ecological, social and institutional context. Disaster risk stems from the complex interactions between environmental sensitivities and vulnerabilities and is further exacerbated by the underlining socioeconomic pressures (Djalante, 2012). O'Brein et al (2006) is of the view that disasters are conditioned by the manner in which society has developed which fuels compounded hazards and vulnerability thereto that, through external events such as storms, may trigger or result in adverse consequences affecting more people overtime, particularly within developing countries.

Climate change affects disaster risk in the following ways, namely through short term climatic variability and by its extreme events influencing the range and frequency of shocks that a system absorbs or adjusts to and through long-term variability that leads to impacts which may change the productivity of natural systems and in turn impact resource dependent societies (Schipper & Pelling, 2006). Climate change magnifies disaster risk by increasing the vulnerability and exposure of coastal communities and ecosystems to its adverse effects. This is especially evident in heavily populated countries. Moreover, climate change will cause extra stress, compound existing problems and most likely create new risks. The literature notes that, traditionally, climate change and disaster risk have been researched separately, but in recent years there has been a bridge between the two discourses through engaging its various stakeholders on ideas of integrating disaster risk reduction and resilience building (Romieu et al 2010; Schipper & Pelling, 2006).

2.5. Human Development in the Coastal Zone

The human factor is a major driver of climate risk. Half of the global population resides within 100km of the ocean as twenty-one of the thirty-three megacities and 41-45% of global economic activity takes place in this zone (Glavovic et al., 2015; Ramesh et al., 2015; Newton & Weichselgartner, 2013). This global move is motivated by economic opportunities and development which in turn increases the risks associated with climate change particularly along the coastal zone. Newton & Weichselgartner (2013) identify four coastal vulnerability hotspots, namely the Arctic coast, small islands, river mouth systems and urban coasts. The authors sought to identify the underlying social and environmental drivers of coastal vulnerability and argue that coastal zones are subject to threats from both land (population growth and human development) and sea (climatic processes fuelled by climate change). High population density, inappropriate coastal urban development, industrial development, tourism and governance failures are some of the major human drivers fuelling coastal risk (Newton

&Weichselgartner, 2013; Priyanto, 2010; Cooper & Mckenna, 2007; Duxbury & Dickinson, 2007). According to Martinez et al. (2007) human shoreline modification and coastal ecosystem exploitation and removal are common features of urban sprawl. Consequently, seaside towns and cities and Low Elevation Coastal Settlements (LECS), will present a great risk to climate change and associated impacts given high urban concertation and development (Cooper & McKenna, 2007; Mcgranaham et al., 2007; Phillips & Jones, 2006). The literature identifies the consequences of human development along the coastal zone given projected sea level rise as being loss of property and damage to real estate, disruption of transport and infrastructure, the increased cost of coastal defences such as sea walls, the threat to coastal dependent communities and loss of livelihoods as well as lives (Davis-Reddy & Vincent, 2017; Mcgranaham et al., 2007; Dolan & Walker, 2006; Klein et al., 2001; Klein & Nicholls 1999; Turner et al., 1996). In highlighting the extent of human intervention in fuelling coastal risk, the role of tourism and port development and expansion has been specifically identified in the literature. Given the relevance of port development and tourism to this study, a discussion of this literature follows.

Tourism is considered the world's largest industry as it boasts major economic growth and development (Toubes et al., 2017; Lakshmi & Shaj, 2016; Kellens et al., 2012; Phillips & Jones, 2006). The coastal and marine environment attracts millions of tourists given its range of leisure activities, hence coastal tourism is seen as one of the fastest growing sectors in the tourism industry (Toubes et al., 2017; Kellen et al., 2012). The lucrative nature and growth of coastal tourism coupled with an increase in coastal development, has posed a major threat to the coast when considering the realities of climate change and the exacerbation of existing risks such as sea level rise, storm surges, flooding and erosion (Toubes et al., 2017; Alexandrakis et al., 2015; Burak et al., 2004; Bellan & Bellan-Santini, 2001). In fact, over the past 50 years there has been a boom in tourism, yet at the same time coastal erosion due to climate-induced SLR has become a severe problem globally (Rangel-Buitrago et al., 2018). The vulnerability of the coastal zone to these compounded risks influences the number of people exposed to these risks. Phillips & Jones (2006) argue that low lying islands with sandy beaches are potentially most at risk of sea level rise as evident in Mauritius and the Maldives where large portions of its scenic beaches have eroded due to rapid rates of sea level rise, thus threating its tourism industry. Similarly, the development of numerous coastal protection projects along the Sri Lankan coast has resulted in the loss of many recreational beaches and impacted the tourist market (Phillips & Jones, 2006).

In the case of India, tourism plays a vital role in contributing to its Gross Domestic Product (GDP), however along Papanasam beach, coastal tourism impacts the carrying capacity of its natural environment. Papanasam beach is a 1.5km stretch of coastline located in Thiruvananthapuram in Kerala, India which has been dramatically transformed due to the increase in leisure and recreational activities which include large scale multi-storey hotels and restaurants. Tourism has also altered the top northern cliff parallel to the beach despite the high risk associated with its development (Lakshmi & Shaji, 2016). Consequently, due to monsoon rains and human development interventions in the area,

the beach has eroded approximately 50m since the early 1960's. Lakshimi & Shaji (2016) argue that, the 'economic prospect' of tourism along Papanasam beach has led to poor land-use planning and ineffective building regulations resulting in sprawling development. It is clear that the short-term economic vision of tourism and leisure activities continue to override sustainable practices along the coastal zone. In the same vein, Phillips & Jones (2006) argue that, given increased rates of tourism and leisure activities, current to medium term development planning practices pay very little attention to long-term coastal management consequences which could prove detrimental.

Port development and expansion is economically necessary yet highly contentious issue. Dredging, which is a major activity of the development process, involves deepening existing ports in order to expand navigation channels (Clark et al., 2018). The literature highlights the economic benefits as being maximizing benefits such as increased production output, greater cargo capacity, increased international sea trade, improved port efficiency, improved competitiveness and local job creation (Vogel, 2015; Felsenstein et al., 2014; Maharaj, 2013; Clark et al., 2012). Maharaj (2013) uses the example of Durban, which houses South Africa's largest port facility, to illustrate the economic opportunities afforded to the country through its development and expansion. The author argues that South Africa's competitiveness in the international market is dependent on the efficiency of its maritime supply chains in enabling export and accommodating raw materials. This is a catalyst for achieving its economies of scale (Maharaj, 2013). Similarly, Vogel et al (2015) argue that, historically, the coastal zone was an economic and industrial centre and continues to support and drive local as well as global economic output through international trade.

Despite the economic opportunities attached to port development, it is regarded as one of the dominant human interventions responsible for coastal erosion. Kudale (2010) is of the view that the use of dredging prior to and during port development interferes with coastal processes in the area and this can have a medium to long-term impact on the coastline. The literature identifies the impacts of port development in relation to dredging as resulting in changes in wave circulation patterns, increased wave heights as a result of wave refraction patterns, increased sediment transportation rates given longshore drift processes and increased potential for beach erosion due to loss of sand sources (Sarma, 2015; Felsenstein et al., 2014; Kudale, 2010; Philips & Jones, 2006).

In highlighting the interconnectedness between port construction and coastal erosion, Sarma (2015) argues that the rate of coastal erosion in Paradip Port in India has intensified due to the deepening of port channels as part of expansion and modernisation. The example of Paradip Port illustrates the extent of erosion impacting the Odisha coast due to the obstruction of the longshore drift (Kudale, 2010). Paradip Port is one of the largest and oldest ports along the Odisha Coast on the east coast of India. The development of the port during the early sixties involved the construction of coastal structures namely groynes, sea walls, two breakwaters and jetties which in turn altered the Odisha shoreline (Mohanty et

al., 2015). Evidently, during the early nineteen seventies, a major cyclone struck the Odisha coast resulting in major erosion along the northern portions (i.e. the downdrift) of the beach given the intrusion of the longshore drift by the breakwater structures. Consequently, the northern portion of the Odisha shoreline has to be regularly supplied with sand in order to minimise the risk of further erosion. This is an ideal example illustrating the effects of shoreline modification due to port development and expansion.

2.6. The Governance of Coasts

2.6.1 Exploring the concept of governance

Governance is at the centre of identifying and implementing effective, context-specific strategies in response to coastal risk. Governance is defined as being concerned with politics and involves interactions between diverse actors within both the private and public domain in solving societal problems and creating societal opportunities (Ren et al., 2011; Dolan & Walker, 2006; Bavinck et al., 2005; Adger 2001). A central element of governance is the sharing of responsibility and power through interaction amongst all relevant stakeholders in fostering decentralised and bottom-up decision-making processes (Lockwood et al., 2012; Bavinck et al., 2005; Arhens & Rudolph., 2006). In defining and unpacking governance, one has to understand the workings of government. Traditionally, the idea of governing was viewed as the task of government who was the single decision-making authority in exerting sovereign control over civil society and the development and implementation of policy (Sowman & Wynberg, 2014; Pahl-Wostl, 2004). The legitimacy of this centralised control exerted by government has been increasingly questioned by citizens. Hence, involvement of non-state actors, networks and partnerships is seen as a means of decentralising decision-making authority (Sowman & Wynberg, 2014; Walker et al., 2014). This conceptualisation of governance gave rise to the shifting role of government and the greater recognition of the important role of other societal actors. According to Bavinck et al (2005) governance, as opposed to government emphasises that the dividing lines between the public and private sector are blurred, thus interests are frequently shared.

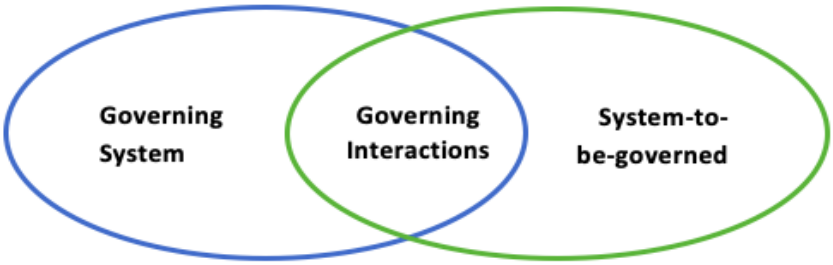

Figure 2: Interconnected nature of governance in relation to the governing system and the system to be governed (source: Jentoft & Chuenpagdee, 2009)

It is useful to draw on Jentoft & Chuenpagdee's (2009) conceptualisation of governance, which explains governance as a governing system and a system to be governed as well as the governing of interactions between the two. Interactive governance, as noted by Jentoft & Chuenpagdee (2009), identifies these three-interacting systems, as is illustrated in figure 2, which ought to be acknowledged when contextualising the complex nature of socioecological systems and their governance. Thus, governance includes the governing system, the system-to-be governed and governing interactions. The governing system refers to the institutional, steering and coordination mechanisms within a given system including local to national institutions, policies and management programmes. The system to be governed, on the other hand, comprises the natural and human system, which refer to the relationship between the local community and resource users with contextually-based social, economic, cultural, political and environmental factors (Jentoft & Chuenpadgee, 2009). As shown in figure 2, the third and central circle within the diagram refers to the governing of interactions between the governing and system-to-be governed. These interactions are attributed to being diverse, complex, dynamic, vulnerable, uncertain and operating at various scales. Jentoft & Chuenpagdee (2009) identify that wicked problems, such as climate change, if addressed as 'tameable', would potentially result in the intensification of the problem. Given that climate change and adaptation strategies are not divorced from one another but rather embedded within the governance process, it reflects the relationship between individuals, their capacity to adapt and the role of institutions (Adger & Vincent, 2005).

Governance is an inclusive process that goes beyond the problems at hand and looks at longer term societal needs and trends. Glavovic (2015) and Lockwood et al. (2012) argue that over the last decade, the notion of governance has gained increased importance given the increasing complexity of environmental change, the non-linear effects that result in instability and unpredictability within an entire system and the inability of central governments to address and solve 'wicked problems'. This realisation has resulted in the move towards integration, decentralization and localization. According to Ren et al. (2011) governance embodies a non-hierarchical organisational structure encompassing the state and non-state actors which facilitate collectively binding decisions. In the context of risk governance, establishing partnerships in the decision-making process is underscored by the involvement of various actors (i.e. horizontal as well as vertical scale) in understanding and assessing risks and working collectively to address these risks (Berman et al., 2012; Walker et al., 2010; Foxen et al., 2008; Berkes, 2007).

Lockwood et al (2012) outline eight key principles which epitomise "good governance", including legitimacy, transparency, accountability, inclusiveness, fairness, integration, capability and adaptability. Arhens & Rudolph (2006) argue that these principles form the overarching guideline in ensuring credible and effective decision-making. In differentiating between governance and management, Bene & Neiland (2006) are of the view that management refers to action and implementation, whereas governance is essentially about setting the policy agenda, objectives and

processes in line with good governance principles. Governance provides a systematic framework underpinned by multi-actor engagement which enables effective management. Good governance enables effective management and encourages sustainable development and risk reduction within the context of complex socio-environmental problems. Therefore, for the benefit of this research, the viewpoint of Mcfadden (2007) will be drawn upon in arguing that good governance acts as the foundation for implementing and achieving effective management.

2.6.2. The Governance of Risk

Risk Governance (RG) is not a new concept and can be traced back to the late 1990's as a government initiative set up by the European Commission. It seeks to translate the principles of governance to the context of risk and risk-related decision-making (Penning-Roswell et al., 2014; van Asselt & Renn, 2011; Jones & Preston, 2010). Risk governance denotes an institutional and policy process that guides collective action of a group or community in regulating, reducing or controlling a risk problem (Klinke & Ren, 2011; Corferr-Morlot et al., 2011; van Asselt & Ren, 2011). As previously argued by Ahrens & Rudolph (2006), governance enables credible commitment to decision-making. Attempts to govern risk have often faced numerous challenges such as the lack of methods for assessing risk, managing across contexts and the inadequate involvement of different stakeholder groups.

According to the International Risk Governance Council (IRGC), risk governance mobilises both descriptive issues (i.e. how decisions are made) and normative concepts (i.e. how decisions ought to be made) as it echoes the principles of good governance (see Lockwood et al., 2010). Walker et al. (2010) argue that risk governance recognises that risks faced by societies such as climate change, are complex and uncertain and require sound decision-making which secures public confidence in responding to them effectively. Risk governance provides a better understanding of risks through exploring scientific, political, social, and economic contexts, thus allowing for appropriate management measures (IRGC, 2017). Klinke & Ren (2011) argue that this multileveled systems approach to risk governance is advantageous when complex risk problems need to be addressed as it allows for risks of different scope and severity to be managed at different levels, which in turn facilitates experimentation and learning amongst actors.

Risk governance adopts a holistic, multidisciplinary and multiscale approach to risk and its analysis. According to Ren et al. (2011) and Kohler et al. (2004) risk governance seeks to understand risk by focusing on prevention (risk analysis) and how to build preparedness for extreme natural events. Traditionally, risk governance focused largely on technological risk and its analysis with very little scope given to environmental/natural risks (Jones & Preston, 2010). Walker et al. (2010) argues that governance issues are vital to all kinds of risk and should not to be side-lined given disciplinary

boundaries. The classic model of risk analysis focused solely on risk assessment, management and communication, thus too narrowly focused on covering a variety of actors' inputs and processes in governing risk (Klinke & Renn, 2011; van Asselt, 2011). Central to risk governance, as outlined in the IRGC, is forward planning which is achieved through promoting open and inclusive risk stakeholder communication and problem-solving (IRGC, 2017; Berkes, 2015; van Asselt & Renn, 2011). Ren et al (2011) and van Asselt & Ren (2011) argue that given the complex nature of risks, the risk governance approach, as presented by the IRGC, is highly flexible in its application to suit case study specific situations.

Therefore, risk governance as an approach to addressing and managing risk has been embraced by scholars and practitioners as viable due to the emphasis placed on the idea that natural hazards and its impact on society are not something new but something constantly interacting, influencing and being influenced by one another. Risk governance considers and identifies all potential driving factors of a given risk(s). Hence risks associated with climate change in the coastal zone such as storm surges, coastal erosion and flooding, need to adopt an explicitly integrative and more specifically a human dimension.

2.7. Approaches to responding to coastal risk

2.7.1. Conventional responses to coastal risk

Responding to climate change is highly context specific and dependent on climatic, environmental, social and institutional factors (Fussel, 2007). The coastal zone is one of the most vulnerable geographic locations to the risks and impacts associated with climate and environmental change (Newton & Weichselgartner, 2013). Major climate-induced coastal risks are flooding, storm surges and erosion which are largely the result of sea level rise. For the purpose of this research, the literature reviewed looks specifically at coastal erosion as a critical impact associated to sea level rise (Rangel-Buitrago et al., 2018; Moser et al., 2012; Brown et al., 2011; Sano et al., 2011; Cazenave & Llovel, 2010; Theron et al., 2010).

Coastal erosion is a gradual yet visible illustration of the extent of climate-induced sea level rise which is compounded human interventions. Sea level rise, as argued by Moser et al (2012) is regarded as the dominant driving force of coastal change. According to the IPCC (IPCC, 2014) coastal areas are projected to face greater risks in light of climate change as it is estimated that global sea level rise will increase given the rise in temperatures of 1.5 degrees Celsius above pre-industrial levels between 2030 and 2052. The climate change discourse associates sea level rise with global warming which, in turn escalates the melting of the ice caps and glaciers (IPCC, 2017; Wang et al., 2014; Cazenove & Llovel, 2010: Brook et al., 2006). As a climate parameter, sea level rise is hard to accurately determine given

the interaction of numerous components such as the warming of the oceans, melting ice sheets and glaciers as well as the human factors such as CO2 emissions at different spatial and temporal scales (Cazenove & Llovel, 2010). The literature identifies the physical impacts of sea level rise as being rising water tables, shoreline erosion, salt water intrusion of groundwater reserves, increase in spring tides and increase flooding of low lying areas due to more frequent and intense storms (Wang et al., 2014; Moser et al., 2012; Brown et al., 2011; Cazenove & Llovel, 2010). Storm intensity is heightened and having more immediate impacts on coastal areas given greater wind and wave energy, thus accelerating coastal sediment loss i.e. coastal erosion resulting in infrastructure and property loss. Brown et al. (2011) add that human induced changes, which include coastal sprawl, overdevelopment and coastal infrastructure such as urban roadways and storm drains along the coastal zone, exacerbate the impacts of sea level rise at a local level. Brooks et al. (2006) notes the following factors as being the consequences of sea level rise depending on a given population and location; the amount of sea level rise projected to occur locally, the interaction and effects it has on associated hazards such as storm surge frequency and intensity. Also, the level of exposure which a population has to the direct impacts of sea level rise and associated hazards, the extent of coastal responses to sea level rise namely, natural or human interventions and the ability of the system to cope with the impacts (Brooks et al., 2006).

One of the visible impact associated to sea level rise is coastal erosion. Coastal erosion is a process which refers to the permanent loss of sand from a beach depending on the beach profile, levels of wave and wind activity, sediment composition and deposition and exposure at different temporal and spatial scales (Rangel-Buitrago et al., 2018; van Rijn, 2011). In highlighting the link between sea level rise and coastal erosion, the Bruun Theory (Schwartz, 1967) notes a ratio of shoreline retreat to rates of sea level rise and found that the material eroded from the upper sections of the beach is equal to the volume of material deposited on the near shore bottom sections, hence the rise of the nearshore bottom sections of the beach due to deposition is equal to the rise in sea level (Schwartz, 1967 in Sano et al., 2011: 949). In essence, coastal erosion, as defined by Rangel-Buitrago et al. (2018) refers to the imbalance between sediment deposition and sediment loss. The broader literature argues that coastal erosion is mainly intensified by human activities such as settlement and development concentration along the coastal zone (Rangel-Buitrago et al., 2018; Seno et al., 2011; van Rijn, 2011). Considering the economic and aesthetic values associated with the coastal zone, coastal erosion results in beach loss, property loss, the deterioration of landscape quality and overall hindrance of economic growth given tourism and related financial investments.

The nature of coastal erosion requires numerous adaptation options which range from technical hard and soft engineering measures as well as integrated collaborative planning. The literature identifies three central options for responding to actual or anticipated coastal change namely protect, accommodate and managed retreat which are further categorized into five approaches namely

armouring, moderating, restoring, abstention and adaptation (Rangel-Buitrago et al., 2018; Williams et al., 2018; Harmon et al., 2015; Klein et al., 2001; Pope, 1997).

The first approach, which is to protect or defend i.e. armouring, constitutes coastal defence structure which consist of hard engineering solutions such as dikes, levees, seawalls, floodwalls, revetments and groynes. Coastal defence measures are built to increase robustness by holding existing defences and or ensuring that the shoreline remains intact. However, hard measures are costly, often of a temporary nature and require maintenance. It is argued that these engineering approaches add to the problem instead of relieving it (Rangel-Buitrago et al., 2018; Sano et al., 2011; van Rijn, 2011). In developing countries, however, hard structural interventions in response to coastal risk are ineffective in isolation without recognising and incorporating soft protection measures such as beach nourishment and wetland creation (Klein et al., 2001).

Moderating or slowing down of erosion rate is appropriate in areas where erosion is due to decreasing sediment supplies. Another approach is restoration or the use of softer techniques include creating sand dunes and beach nourishment. This measure seeks to work alongside rather than against natural coastal processes (Rangel-Buitrago et al., 2018; Williams et al., 2018).

Abstention is another approach identified by the literature in controlling erosion. This approach entails having no active interventions and allowing nature to take its course. Managed retreat is an example hereof. Managed retreat is regarded as a proactive measure in moving or relocating people, buildings and infrastructure inland, demolishing or allowing them to degrade in order to avoid uncertain and negative outcomes from occurring. This approach is less costly and essentially enhances adaptability and risk reduction in the form of establishing and or increasing setback zones, and phasing out development in high risk areas (Rangel-Buitrago et al., 2018; Williams et al., 2018; Harmon et al., 2015; Klein et al., 2001).

Coupled with managed retreat, designated setback zones or lines are effective planning measures in response to coastal change and risk. Given the extent of development along the coast, coastal setback zones provide a buffer area where no permanent construction is allowed (Sano et al., 2011). According to Williams et al. (2018) two kinds of coastal setback zones exist when dealing with soft sandy beaches namely, vertical setbacks which refer to the height bench mark above sea level and a horizontal setback which refers to the distance from the sea landwards which is considered vulnerable to coastal risk hazards. Coastal setback zones act as a precautionary response and are considered a long-term response to minimizing infrastructure damage due to coastal erosion and flooding. These measures are a lower cost alternative to constructing physical coastal structures.

The “accommodate” or “adaptation” approach is based on the idea of increasing flexibility in allowing the continued usage of the area without attempting to prevent damage to the environment or people

from natural events. This approach is low to no cost and includes processes such as wetland restoration, modifying coastal building codes, emergency planning, hazard insurance, improving drainage and maintaining strict regulations of identified hazard zones such as building regulations and setback lines.

According to Klein et al (2001) these responsive interventions mentioned have been instrumental in reducing vulnerability to coastal hazards as they aim to protect, facilitate retreat and accommodate change and impacts, given specific contexts. Coastal adaptation options are influenced by existing policies and more effective when incorporated into coastal zone management frameworks, land use planning and sustainable development strategies (Harmon et al., 2015; Smit et al., 2001). Similarly, Klein et al (1999) identifies four steps for adapting to climate-induced coastal change which is centred on being a multistage and iterative process. The first step is information and awareness creation relating to the anticipated coastal risks, their impacts and the interaction between climate related impacts and non-climate drivers. The second, planning and designing of adaptation options which are influenced by cost effectiveness, social equity and environmental sustainability. The third step focuses on implementation of options which need to be tailored to particular risks and contexts and lastly, monitoring and evaluation which is an ongoing activity (Klein et al., 1999). The literature notes that even though technological or structural coastal adaptation options are useful in limiting the risk probability and potential effects thereof, it should not be regarded as the universal solution as its effectiveness is highly dependent on the economic, sociocultural and institutional contexts in which they are implemented (Harmon et al., 2015; Hofman et al., 2015; Glavovic et al., 2014; Smit et al., 2001; Klein et al., 2001; Klein et al., 1999). For instance, Harmon et al. (2015) argues that in terms of managed retreat and accommodation measures, the management of climate and human-induced coastal change requires a more integrative approach as it creates awareness of the role of coastal structures in lessening the potential impact of coastal risks within a short to medium term timescale. It also increases the involvement of numerous actors in the decision-making process in adapting to its long-term effects. Glavovic et al (2014) add that building resilience to these adverse effects is a multidisciplinary and cross-scale undertaking, thus understanding its complexity is central to the development and implementation of effective adaptive strategies. Therefore, the integration of numerous anticipatory adaptation approaches ranging from structural “hard” to “soft” measures, to encouraging collaborative engagement of stakeholders in the planning and implementation of these measures, is crucial in building greater adaptive capacity to coastal change.

2.7.2. Coastal Risk Governance (CRG) as a new approach to risk governance

Climate change and its associated risk is an ongoing challenge facing coastal environments and communities, despite measures being employed for its governance. Jentoft & Bavinck (2014) argue that within a given system, such as the coastal environment, the simplistic, one-size fits-all approach is

unlikely to succeed due to its failure to foster collaboration and integration amongst all interested and affected parties. The complexity and system uncertainty surrounding coastal risk suggests the need for a new approach, one which relies on inclusive and participatory stakeholder judgement within a process aligned upon interactive, holistic, collaborative and adaptive governance approaches (Jentoft & Chuenpagdee, 2009).

It has been argued by Jentoft & Chuenpagdee (2015 & 2009) that environmental issues are 'wicked problems' which require a new approach to its governance. In expanding on the notion of 'wickedness' in terms of environmental problems, Head & Alford (2015) outline it as being a symptom of a broader problem which cannot be solved in isolation. These problems are associated with multiple interests and values, institutional complexity and scientific uncertainty, hence the more complex a situation, the more wicked the problem (Head & Alford, 2015). To illustrate this, Balica et al. (2012) argue that the wickedness of environmental problems is central to the idea that within a system, such as the coast, various issues of a social, economic, institutional and ecological nature are interacting hence, when dealing with one particular issue, one unintentionally deals with another.

Given the many pressures facing the coastal zone, scholars recognized the need to analyse the interrelated natural and social drivers of coastal change from a holistic and integrated perspective (Folke et al., 2016; Ramesh et al., 2015; Cheong, 2008). In highlighting the significance and complexity of the coast zone, Martinez et al. (2007) argue that collaborative and integrative thinking on how to best deal with extreme natural events, are becoming increasingly necessary and mandatory. Similarly, Cheong (2008), Bavinck et al. (2005) and Turner et al. (1996) are of the view that given the contemporary challenges impacting the coastal zone namely, climate-induced sea level rise and urban development, there is a growing need for solutions to these complex environmental problems to move beyond boundaries and away from the 'one-size-fits-all' approach. This shift is necessitated by interdisciplinary, interactive and holistic thinking and approaches.

Coastal risk governance is an alternate approach to dealing with wicked issues such as coastal risk (Kirk, 2015; Jentoft & Bavinck, 2014; Ziervogel et al., 2014; Lloyd et al., 2013; Popescu, 2013; Kotze, 2006; Mahone et al., 2005; Pen, 2005). It speaks to peoples' needs and moves away from curing to problem prevention, focusing on outcomes rather than measure of activity as well as information and persuasion instead of coercion and command (Jentoft & Bavinck, 2014). Bavinck et al. (2005) note that this governance approach transcends a problem-solution focused approach, instead brings together different interests as well as explores various opportunities. According to Jentoft & Chuempagdee (2015) and Kotze (2006), 'active involvement' necessitates coexistence, collaboration, coordination, cooperation and integration of ideas and knowledges. Furthermore, this participatory approach recognises local and expert knowledge as being complimentary to conventional science which results in greater harmonisation of relationships and mutual coordination (Bavinck et al., 2015; Jentoft &

Bavinck, 2014; Sowman & Wynberg, 2014; Chuenpagdee & Song, 2012). Lloyd et al. (2013) goes on to say that acquiring a shared or integrated understanding of risks is predicated on creating more robust and meaningful collaboration which fosters an appreciation for the interdependency and co-existence of governance and the environment, such as in the case of the coastal environment.

Integrated or holistic thinking in relation to a given socio-ecological system such as the coastal zone, facilitates dialogue, cooperation and coordination of sectoral, locality and issue-specific responses that recognise interdependence and diverse perspectives (Glavovic et al 2015). The literature notes that integration enables the implementation of collaborative and coordinated ideas (Bavinck et al., 2015; Sowman et al., 2014; Glavovic, 2013; Jentoft & Chuenpagdee, 2009; Kotze, 2006; Bavinck et al., 2005; Mahone et al., 2005). Popsecu (2013) makes reference to 'networks as innovative forms' in legitimising decision-making and enabling citizen involvement in the implementation process. The author further stresses the importance of co-production as an overarching characteristic of this new governance approach. Co-production improves public collective organisation by providing an open network enabling trust through dialog at every stage of the decision-making process, thus building accountability and transparency (Bavinck et al., 2015; Glavovic, 2013; Lloyd et al., 2013; Posecu, 2013).

At the same time, this new risk governance approach engages the notion of adaptive capacity and adaptability and its role in fostering effective responses to cope with periods of rapid change in order to take advantage of new opportunities within the system (Cooper & Wheeler, 2015; Folke et al., 2005). This is centred upon experimentation and learning as a means of building knowledge to better prepare for uncertainty. Folke et al. (2005) and Armitage et al. (2009) add that learning and experimentation helps develop adaptive capacity as well as expertise through innovation to deal with change within the system. The literature outlines the importance of facilitating collaborative and polycentric decision-making across scales, building knowledge through integrative and innovative environmentally sustainable thinking in responding to non-linear socioecological feedbacks (Cooper & Wheeler, 2015; Folke et al., 2015; Djalante, 2012; Armitage et al., 2009; Folke et al., 2005).

In contextualising the need for a new risk governance approach, one which is based upon interactive, holistic, collaborative and adaptive approaches, the example provided by Ziervogel et al. (2014) in the context of flood risk governance within informal settlements in Cape Town is useful. Ziervogel et al. (2014) argues that, in the case of flood risk, a paradigm shift is required from addressing its management through a compartmentalised and technical approach to a more holistic approach centred upon collaboration between internal and external actors. Certainly, creating dialogue through consistent collaboration establishes holistic approaches to bridging competing mentalities, which underpins the role of actor involvement in shaping sustainable futures (Ziervogel et al., 2014).

In line with the above-mentioned case study, Jentoft & Chuepagdee (2009) as well as Bavinck et al. (2015) assert that the failure of traditional governance approaches lies in the perception that complex problems such as coastal risk, are tameable, instead the context-specific nature and uniqueness of these problems need to be accounted for. Therefore, solutions to complex problems are not solely technical but involve institutional, social, economic as well as environmental considerations.

2.8. Examples of integrated responses to coastal risk

In this section, three case studies are presented in highlighting good examples of different insights and responses to addressing coastal risk and its governance. These examples include Sao Paulo in Brazil, Beira in Mozambique and Durban in Kwazulu-Natal, South Africa.

2.8.1. Sao Paulo, Brazil

With a coastline spanning 8698km, Brazil is one of 15 countries that is highly populated in low elevation coastal areas (Marengo et al., 2017). One of Brazil's most populated and economically industrialised coastal cities is Sao Paulo. The Sao Paulo shoreline, which stretches for 700km, is characterized by major urban centres, ports and industries that support local and national infrastructure development as well as several protected areas rich in biodiversity and ecology (Da Coasta Ferreira et al., 2011). At the same time, the shoreline is highly exposed to the risks associated with climate-induced sea level rise, which has risen between 1.8mm to 4.4mm annually since 1950 (Marengo et al., 2017). Souza (2001) notes that 430km of the Sao Paulo shoreline comprises of sandy beaches hence, coastal erosion is a constant threat which is attributed to natural processes and enhanced by anthropogenic pressures. According to Souza & Sagdio (2003) 66% of Sao Paulo's shoreline is classified as at very high to high risk of climate-induced risks.

Based on a vulnerability study conducted by Zanetti et al. (2016), Santos, a coastal municipality, is identified as being one of the most at-risk areas along the Sao Paulo shoreline. Research has shown that 70% of the Santos area is regarded as highly vulnerable due to 99% of its population residing in highly concentrated urban areas in close proximity to the coast (Zanetti et al., 2016). Consequently, Marengo et al. (2017) state that the mean sea level rise for Santos has been approximately 1.2mm annually since 1960. Girard (2017) adds that given climate change projections for Santos, sea level will rise about 30cm by 2100. The impacts associated with extreme storm events in Santos include heavy rainfall, high tide and wave action, inundation, beach erosion which results in reduced sand supply, infrastructure damage, loss of coastal ecosystems, loss of land and property, impact on tourism and economic losses (Souza, 2001).

The Brazilian government introduced Integrated Coastal Zone Management (ICZM) as a comprehensive response to coastal risks. The ICZM was institutionalised in 1998 and sought to improve

land use control and monitoring along the Brazilian coast. ICZM was first introduced in Sao Paulo in 1998. Similarly, at a city level, the Santos Metropole introduced COAST, a coastal adaptation tool for sea level rise. COAST is a model for multiple users from different spheres of government, state agencies and community groups interested in identifying context appropriate adaptation strategies aimed at reducing the damage of sea level rise and associated impacts (Marengo et al., 2017). It identifies at-risk coastal areas as well as visualises and calculates potential infrastructure impacts from sea level rise and provides an ideal tool for stakeholders to articulate and modify potential adaptation strategies through engagement. In the case of Santos, adaptation responses include improved tidal control gates, beach nourishment and dune restoration and preservation projects as well as coastal structural enforcement and maintenance.

2.8.2. Beira, Mozambique

Mozambique has the world's fourth longest coastline extending 2800km and is a central focus for tourism, recreational and industrial activities. The Mozambique coastline is deemed highly vulnerable to climate change impacts due to its vast low-lying coastal plains, high population concentration in close proximity to the ocean, soft erodible coastline and inadequate and outdated coastal defences (Domingos, 2016; Theron et al., 2012; Chemane et al., 1997). Given the geographical positioning of Mozambique, its coastal cities are directly exposed to high waves and cyclone impacts. Between 1956 to 2008, the country experienced 13 intense tropical cyclones which resulted in major impacts on the lives and livelihoods of its coastal residents (Nuemann et al., 2013).

Beira, the second largest coastal city in Mozambique, is most at-risk to these climate-induced impacts based on vulnerability studies by Domingos (2016) and Theron et al. (2012). Beira is located in the central region of Mozambique at the mouth of the Pungue River. According to several scholars, the city is at very high risk of erosion given human pressure and severe high tidal and wave action along its coastline, thus experiencing a mean annual erosion rate of 1.2mm/year (Domingos, 2016; Palatane et al., 2016; Theron et al., 2012). Furthermore, Beira is situated at a low elevation and vulnerable to sea level rise which, given its susceptibility to tropical cyclones, will increase in frequency and intensity (Neumann et al., 2013).

Considering the multiple climate and human-induced processes affecting the Mozambique coast, in 1994, national government passed the National Environmental Management Act which gave rise to Integrated Coastal Zone Management (ICZM). ICZM emphasises communication and coordination amongst stakeholders through adopting a collective, participatory and harmonised management approach to accommodating and planning for change (Chemane et al., 1997). ICZM also integrates coastal planning and management through holistic planning and development, develop opportunities for public-private partnerships, continue active stakeholder engagement and ensure ongoing monitoring, evaluation and decision-making (Theron et al., 2012). At a city level, ICZM fosters site specific adaptation options in managing the impacts of current and future climate and human-induced

change. In the case of Beira, management options included developing coastal setback lines or zones, awareness, raising properties, and engineering measures like sand nourishment, sea walls, revetments, dikes and groynes which were implemented across its coastal areas based on level of risk and exposure. However, despite these measures, the recent Tropical cyclone Idai caused catastrophic damage particularly in Beira and along the Mozambique coast, Malawi as well as Zimbabwe resulting in thousands losing their lives.

2.8.3. Durban, KwaZulu-Natal in South Africa

The KwaZulu Natal (KZN) coastline stretches for 580km and is characterized by diverse social, economic, industrial and ecological activities. Apart from the coast's complex nature, this low-lying strip of land is highly susceptible to climate-induced risk which are further exacerbated by human pressures. The shoreline is susceptible to sea level rise which are projected to rise to 30cm in the coming decades and associated impacts like severe storm events, flooding and coastal erosion (Smith et al., 2013; Palmer et al., 2011). This coastline is accustomed to severe storm events given its geographical position along the eastern shores of South Africa which bear the knock-on effects of dissipating tropical cyclones (Mather & Stretch, 2012). In 1966, for instance, a storm with wave heights of 8.8m stripped the Durban beach of most of its sand supply. Then the storm of 2007, which is regarded as one of the most destructive storms of all time, struck the coast of KZN with very high swells resulting in large scale erosion and flooding. In 2011 another storm hit the coastline, which was less destructive but characterised by inshore waves reaching 4.5m, strong winds and flooding which destroyed numerous coastal defences (Smith et al., 2013). According to Breetzke et al. (2008) sandy shores along the KZN coastline have become highly vulnerable ever since the 2007 storm. This was due to the extent of impact which was fuelled by its narrow, sand depleted beaches, the removal of natural beach defences, coastal development built in close proximity to the shoreline and high-water mark, poorly maintained storm water systems and in certain locations, inappropriate sea defences. The literature notes that the KZN coastline is diminishing at a rate of 3.2mm annually, which, given projected sea level rise, is likely to experience increased episodic storm events resulting in greater erosion rates and infrastructure losses (Smith et al., 2013; Mather & Stretch, 2012; Roberts, 2008).

Responding to coastal risks requires proactive and collaborative efforts which is evident in the KwaZulu Natal example. At a national level, the Integrated Coastal Management Act (ICM Act) was promulgated in 2008 and is underpinned by a set of principles for sustainable coastal development. The ICM Act is premised on the need to adopt a collaborative and integrated approach for effective coastal management and this approach is required at provincial and local level. In line with the ICM Act, at a provincial level, numerous risk aversion and precautionary measures have been developed in response to coastal risks along the KZN coast. This includes establishing coastal setback lines, which in this province are set at 10m above sea level.

Municipal responsive mechanisms to coastal risk include developing emergency responses such as utilizing geo-fabric sand bags in the event of a storm, hard and soft engineering measures such as revetments, groynes, dune rehabilitation and maintenance as well as managed retreat of at-risk buildings and properties. Also, appropriately reconstructing coastal infrastructure and amenities as well as engaging with coastal property owners regarding preparedness, monitoring and reactiveness in the event of storms. These measures are part of the KZN provincial government's approach. For instance, Durban, under the jurisdiction of the eThekwini Municipality, has developed sea level rise models for evaluating coastal development proposals as well as adopted and reinforced coastal management lines and identified risk zones. The municipality has also approved policies for managing the existing building environment along its coastline. This was achieved through using a risk-averse approach which integrated spatial, land use and infrastructure planning with development control (Roberts, 2010; Breetzke et al., 2008).

2.9. Concluding remarks

The coastal zone is regarded as a complex system because of the human-environmental interplay that exist within this space. Coastal risks, such as flooding and erosion, which are becoming more prevalent, are multifaceted and complex in nature. Trends in the literature acknowledge the multifaceted nature of coastal risk and that conventional governance approaches to responding to coastal risk are reactive in nature with little consideration of long-term sustainability and do not fully capture the system's complexity, which in many instances add to the problem instead. It does advocate for interactive, holistic, collaborative and adaptive governance as an alternate and constructive response to conventional governance, as it embodies decentralisation, participation, coordination and integration of different knowledges and inclusive of multiple stakeholders (Glavovic, 2015; Lockwood et al., 2012). Furthermore, the literature denotes that strengthening relationships and communication between knowledge producers and decision-makers in response to the uncertainty associated to coastal risk is a further benefit of this new approach to the governance of coastal risk.

Chapter 3

Research Approach and Methods

3.1. Introduction

Chapter 3 will be outlining the research approach and methods employed in this project. This research was guided by complex systems thinking and used qualitative research methods. As outlined by Punch (2005) and Massey (2002) qualitative research has a much wider range of possible empirical materials in engaging with respondents. The approach to the research was using a complex system thinking lens to analyse the Langebaan coastal erosion problem. The main methods employed were semi-structured interviews and the review and analysis of grey literature. The approach to data collection and analysis is also presented in this chapter. This chapter will also reflect on the ethical considerations as well as limitations and challenges of undertaking this research.

3.2. Research Approaches

3.2.1. Complex systems approach

The complex systems approach provides the theoretical framing of this project. This approach, which provides a new way of thinking in contrast to reductionist, deterministic and objective scientific approaches, seeks to understand the relationships between a system as a whole and its parts. As outlined by Nowothy (2005) and Morin (1992), the idea of holism emphasises that the system as a whole is greater than the sum of its parts, thus a holistic view of a system is vital in contrast to understanding the properties of its parts. This approach advocates connectedness, interaction and integration amongst different parts of a system. Cilliers (2008 & 2001) argues that in order to fully understand a given system, one is required to understand it in all its complexities and interactions. Furthermore, the complex systems approach acknowledges the unpredictability of a system as components interact in a dynamic manner which are dominated by non-linear interactions in which small causes may have large effects as changes in one part of the system will induce changes in another, resulting in either positive or negative feedbacks (Cilliers, 2000; 1998; Morin, 1992). As an approach, complex systems thinking underscores the importance of contingent factors in considering the specific conditions which embodies a particular context in a given time (Cilliers, 2001). Using environmental issues such as climate change as example, the 'wickedness' of these issues could only be understood within a complex system thinking lens as it involves comprehending the interactions between the natural and human systems given the reciprocal relations and feedbacks that occur in such systems. Therefore, with regards to the governance of these systems, complex system thinking as an approach enables greater interrogation of interdependence and cross-scale linkages of the human systems in relation to the natural systems being investigated.

3.2.2. Case study approach

A case study is defined as an explorative and comprehensive description of individuals, groups, phenomena or particular institutional cases and its analysis (Starman, 2013). Case studies provide a rich in-depth exploration from different perspectives of the uniqueness and complexities of a particular system in understanding the multifaceted nature of the phenomenon. Furthermore, they are used to focus on a particular unit of analysis (e.g. an event or phenomenon) in order to understand it in great depth in relation to a particular study site. Mohn Noor (2008) argues that the use of case studies is useful in capturing the emergent and immanent properties of real life activities and changes in their interactions, thus allowing for context-dependent experiences to be highlighted and unpacked. The case study research approach provides the methodological tool for studying complex phenomena within their contexts holistically, analytically and or culturally (Baxter & Jack, 2008).

The merits associated with the case study approach are that it answers the 'how' and 'why' questions, it covers contextual conditions because of relevance to understanding a given phenomenon and navigates boundaries which are not clear between the phenomena and context (Baxter & Jack, 2008). Moreover, this approach enables greater conceptualization, defines new hypotheses, explores various causal factors and assesses complex relations within a given context which is valuable in developing new theory, evaluating programmes and/or developing interventions (Starman, 2013).

3.3. Methods

3.3.1. Semi-structured Interviews

Semi-structured interviews were used as a central methodological medium. In terms of the structure of the semi-structured interviews, mainly open-ended questions were used. This type of interview approach is not highly structured or unstructured. It provides general guiding questions but allows space for the participant to respond in a more open and flexible manner. The open-ended questions used provided the participant some freedom to divert from the topic, hence enabling probing of certain responses or follow up queries to be identified, clarified and answered in contrast to the direct question and answer format (Adams, 2015; McIntosh & Morse, 2015; Babbier & Mouton, 2001). Barribal & While (1994) add that semi-structured interviews are ideal for a diversity of participants in exploring interpretations and opinions regarding complex issues.

Purposive non-probabilistic sampling was used. This form of sampling denotes that members of the sample were chosen because of a particular characteristic and/or represent a particular location which the sampling selection criteria were informed by the aim of the study. In terms of the sample size, 24 participants were interviewed through the use of snowballing. The criteria included involving a diverse set of actors directly as well as indirectly involved in Langebaan's coastal erosion problem, including those impacted by coastal erosion, those responsible for managing erosion, those with expert technical

knowledge on the problem and those concerned about future erosion and its management. In order to ensure the concerns and interests of all participants were gathered, a general semi-structured interview questionnaire was developed and adapted for different cohorts of participants. This was applicable as participants reflected government officials across three governmental spheres, the private sector, non-governmental organizations as well as local residents. The process involved modifying certain questions in order to capture the diverse interests and views of participants. For example, questions pertaining to environmental legislation, policy and institutions to address coastal risk were directed at governmental officials, whereas questions requiring personal experiences were addressed to local non-governmental organisations and residents. Questions requiring technical information and insights of coastal risk were included for coastal engineers. The various participants interviewed are listed below. As means of maintaining anonymity, no names are provided, only their job description and organisation.

3.4. Data Collection

3.4.1. Participant profiles for the semi-structured interviews

No.	Participant profile
1	National Department of Environmental Affairs – Oceans & Coasts
2	National Department of Public Works – Town Planner
3	National Department of Environmental Affairs – Former Coastal Management Division – Senior Official
4	Western Cape Department of Environmental Planning & Development – Policy & Programmes
5	Western Cape Department of Environmental Planning & Development – Coastal Planning & Impact Management
6	Western Cape Department of Environmental Planning & Development – EIA & Development Management
7	West Coast District Municipality – Conservation & Environment
8	West Coast District Municipality – Disaster Risk Management – Senior Official
9	Saldanha Bay Municipality – Former Municipal - Senior Official
10	Saldanha Bay Municipality – Heritage & Environmental - Senior Official
11	Saldanha Bay Municipality – Town Planning – Official
12	Saldanha Bay Municipality – Fire & Disaster Risk Management – Senior Official
13	Saldanha Bay Municipality – Former coastal patrol officer
14	Saldanha Bay Municipality – Mayoral committee member
14	Langebaan Ratepayers and residents Association member
15	Saldanha Bay Water Quality Trust Forum member
16	Coastal Engineer
17	Coastal Engineer
18	Local Resident – Langebaan North Beach
19	Local Resident – Langebaan North Beach

20	Local Homeowner – Leentjiesklip Caravan Park
21	Local Homeowner – Leentjiesklip Caravan Park
22	Local Fisherman & SANPARK Ranger
23	Local Fisherman
24	Restaurant Manager

Table 1: List of participant profiles for the semi-structured interviews

3.4.2. Grey Literature Review

In complementing the semi-structured interviews, a review of grey literature was also undertaken. Grey literature refers to documents that have not gone through peer review and have been published in non-commercial forms such as government reports, policy statements, issue papers and conference proceedings. For the purpose of this project, government documents relevant to the topic at all levels of government were reviewed. These government documents included municipal documents such as the Saldanha Bay Municipality Second Generation Coastal Management Programme 2019-2024 and the Saldanha Bay Municipality Spatial Development Framework (SBMSDF) 2019, provincial and national policies and legislation, as well as minutes from the Saldanha Bay Integrated Task Team meeting. The content of this literature was reviewed in order to understand the local context, the nature of the natural hazard occurrence, preparedness for the event, the extent of its impact and the responses to the erosion. The grey literature which was identified spanned over the past 20 years.

As part of the literature review, relevant national environmental legislation in relation to environmental and coastal management, as well as climate change was reviewed. Local municipal plans, programmes and guidelines relevant to managing coastal risk were also reviewed.

3.5. Data Analysis Method

Thematic analysis was used in analysing the interviews. Thematic analysis focuses on identifying and analysing patterns or themes as presented within the data. Categorising data into themes provided a systematic approach to data analysis as it highlighted dominant themes from the rich detailed data provided. The dominant themes that were identified in the interview data are as follows:

- Stakeholder perception of coastal risk;
- The various local responses to address coastal risk along the Langebaan shoreline;
- The local barriers to effective governance of coastal risk; and
- Proposed local measures to strengthening coastal risk governance in the Saldanha Municipal area

As part of the data analysis process, participants were coded. Coding involve assigning a label comprising of letters or numbers or a mixture of both to research participants. In terms of interview

data, codes are used to protect the confidentiality and anonymity of participants (Elliott, 2018). Codes conceal participants' names from being associated with their interview responses. In the case of this research, given the controversial nature of coastal erosion along the Langebaan shoreline, codes were used instead of names in referring to research participants. This proved effective in allowing participants to freely air their views regarding the topic.

3.6. Research Limitations and Challenges

In conducting this research, limitations and challenges emerged. The main limitation was participant availability. Although, snowball sampling proved effective, participant availability was a limitation within the given fieldwork timeframe. Participants were either unable to meet the researcher in person or the researcher was unable to meet with the participants due to inconvenient meeting times. It should be noted that the researcher acquired the help of a research assistant given his speech impairment. Some participants suggested meeting times which were inconvenient to the researcher and his assistant. In this instance, participants who were unable to meet in person agreed to engage electronically via email. Four interviews were successfully scheduled and completed through this electronic medium.

A further issue that needs to be raised is the researcher's own positionality within the research. As a person of colour entering a predominantly white and affluent space, many views expressed during the interviews regarding Langebaan's eroding shoreline were not entirely shared by the researcher, considering the broader socioeconomic and political factors that are at play. Despite this, the researcher remained unbiased throughout the research process.

Chapter 4

South Africa's Policy and Legislative Framework for Governing Coastal Risk

4.1. Introduction

The South African coastal zone is a dynamic and strategically important complex socio-ecological environment. In light of its importance, numerous legal and policy frameworks have been promulgated to promote the effective governance thereof (Colenbrander & Sowman, 2015). Furthermore, the nature of South Africa's current legislative framework in relation to environmental issues is one that requires a high degree of networking and inter-sectoral, intergovernmental collaboration (Vermaak & van Niekerk, 2004). This chapter will unpack these various policy and legislative provisions pertaining to coastal risk with a particular focus on provisions to address climate change. This chapter will be reviewing the National Environmental Management Act No. 107 of 1998 (NEMA), the NEM: Integrated Coastal Management Act No. 24 of 2008, the Disaster Management Act No. 67 of 2002, the National Climate Change Bill and the National Climate Change Adaptation Strategy. It will also examine the "Green Book", a recently developed sustainable and adaptive planning tool in response to climate and human-induced change (CSIR, 2019; Van Niekerk et al., 2019). At the local governmental level, policies identified in response to coastal risk in the Saldanha Bay Municipality will also be outlined. In reviewing these legislative provisions, this chapter seeks to highlight the efforts to foster cross scale integration across sectors and collaboration amongst stakeholders (i.e. state and non-state actors) within the context of continuous human and climate-induced pressures along the Western Cape coast.

In engaging the legislative frameworks relevant to governing coastal risk, the complex system of management decision-making at various levels in South Africa becomes apparent. The decision-making powers at various levels of governance influence how government actors execute their functions and activities in response to particular events. Coastal management in South Africa operates at the national, provincial and local levels. Coupled to the management levels, Van Niekerk (2005) also identifies three decision-making levels, namely strategic i.e. national sphere, tactical i.e. provincial sphere and operational i.e. local sphere. Strategic level decisions, which are located within the national sphere of government, are made in response to broad and complex problems given different macro factors such as socio-cultural, economic, political and environmental (van Niekerk, 2005). In light of these complex problems, strategic decision-making allows government to develop long-term plans of action in response to external threats. At this level, decision-making outcomes filter through to the provincial sphere and down to local sphere. Tactical level decision-making, which is evident within the provincial

government sphere, is tasked with aligning with the aims and implementing the objectives set out by national government, while maintaining its provincial autonomy. The operational level, the third of the decision-making levels, is located within the local sphere of government. This level is a crucial element of the legislative hierarchy as it is here where decision-making is targeted at implementing plans, policies and procedures which relate to strategic and tactical decision-making (van Niekerk, 2005). In other words, municipalities or local government ensure that the national policies and provincial strategies are carried out. For the purpose of this study, it should be noted that all three spheres of government and levels of decision-making act as interlocking pieces of the broader puzzle and are vital to policy development and actualisation. By unpacking the various legislative frameworks in relation to addressing coastal risk, the responsibilities and functions of each sphere of government will become apparent.

4.2. Constitution of South Africa of 1996

The Constitution forms the supreme national law for South Africa and is underpinned by the principle of equality. The Constitution ensures and preserves the freedoms of all South African citizens. The Bill of Rights as outlined in chapter 2 of the Constitution identifies the human rights of South African citizens, one of these basic rights is the right to a safe 'environment'.

According to chapter 2, section 24:

"Everyone has the right—

(a) to an environment that is not harmful to their health or wellbeing; and

(b) to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures"

Section 24 echoes the value of preserving the natural environment, which includes the coastal zone, and the need for monitoring in order to mitigate any impacts thereon from external factors. Despite section 24 not making explicit reference to coastal risk, it draws on the broader ideas of sustainability in relation to external environmental change. The Constitution, as outlined in section 41, makes reference to the need and importance of co-governance which should be harnessed and filtered to all spheres of governance, especially at the local sphere (Goble et al., 2014).

According to chapter 3, section 41:

"All spheres of government and organs of state within each sphere must –

(h) co-operate with one another in mutual trust and good faith by—

(i) fostering friendly relations;

(ii) assisting and supporting one another;

(iii) informing one another of, and consulting one another on, matters of common interest;
(iv) co-ordinating their actions and legislation with one another;
(v) adhering to agreed procedures"

In addition, section 41 highlights the need to build capacity at and within all spheres of government. Using sections 24 and 41 as background, in the case of coastal risk, the coastal zone ought to be protected through sustainable practices in reducing the effects of external environmental changes and associated impacts such as flooding, erosion and storm surges. Furthermore, the preservation and management of this vulnerable environment from external influences should not only be attained through reactive measures, but as proactive measures centred upon holistic, cooperative and inclusive decision-making. This approach to promoting environmental sustainability of our coastal zone is legislatively required through other policies and laws such as the Disaster Management Act No. 67 of 2002, NEM: Integrated Coastal Management Act No. 24 of 2008, Climate Change Bill and National Climate Change Adaptation Strategy. For the benefit of this study, the above-mentioned legislation will be unpacked in relation to coastal risk. Ultimately, the idea of fostering sustainable practices in ensuring the longevity of the natural environment for all is central to the protection of the environmental right.

4.3. White Paper for Sustainable Coastal Development in South Africa (2000)

The Integrated Coastal Management Act (ICM Act) is recognized as one of the most critical pieces of legislation pertaining to the coastal zone within South Africa. Prior to its promulgation, the ICM Act, underwent numerous iterations. Goble et al. (2014) highlight that these changes started in 1998 with the publication of a Green Paper i.e. Towards Sustainable Coastal Development in South Africa, and cemented the foundations for the White Paper for Sustainable Coastal Development in South Africa in 2000. According to Goble et al. (2014) and Glavovic (2006) the White Paper provided a paradigm shift in terms of coastal management from one centred upon purely conservation to one underpinned by sustainable development. The White Paper recognized the need for the coast to be viewed and managed as an holistic system rather than be compartmentalised and managed by various sector departments. It aimed at sustainable development by not only improving the environmental functioning of the coast, but also through improving the quality of life of all South Africans, especially those reliant on the coast (DEAT, 2000). The White Paper is underpinned by the principles of holism, integration, people-centred approaches, participation, management and cooperative governance and highlights the need for the coastal environment to be managed through an integrative approach. Glavovic (2006) argues that the White Paper outlines the aims and objectives for attaining sustainable coastal development and management, and provides a plan of action on how to attain those objectives. One of its major underpinnings, as mentioned, is the prospect of people-centred management and capacity building and fostering new partnerships between role players (Glavovic, 2016; Goble et al., 2014).

In terms of coastal risk, the White Paper refers to the need to consider physical coastal dynamics and processes in coastal management and development planning. The policy outlines that areas at high risk and prone to coastal hazards need to be identified and managed by adopting a precautionary risk averse approach in order minimize the need for engineering interventions (Glavovic, 2016; DEAT, 2000). Similarly, appropriate preventative and adaptive measures must be adopted and incorporated into all coastal planning and management decisions and actions, with particular attention being given to the impact of sea level rise on low-lying areas, densely populated coastal areas and coastal infrastructure. In essence, the White Paper calls for cooperation and partnerships between various levels of government, the private sector, the research community and civil society in promoting practical yet effective environmentally, socially and economically sustainable coastal development and management

4.4. National Environmental Management Act No. 107 of 1998

The National Environmental Management Act 107 of 1998 (NEMA) forms the framework legislation for environmental management in South Africa. NEMA stems from the Environment and Conservation Act 73 of 1989, which, despite providing protection of the environment, does not give effect to section 24 of the Constitution, thus necessitating a new legal environmental framework (DEAT, 2000). The publication of the Environmental Management Policy in 1997 formed the basis for NEMA which was enacted in 1998. NEMA provides comprehensive protection and management of the environment through encouraging cooperative governance. Cooperative environmental governance is one of the major objectives of NEMA underpinned by integrated decision-making. Chapter 2 of NEMA outlines the value of institutions in facilitating cooperative environmental governance. It emphasises the importance of environmental management as an integrated process given the interlinked and interconnected nature of the environment. NEMA reinforces that the complexities of the links between the natural and social dimensions of the environment must be considered during decision-making process. Furthermore, NEMA realises this through the promotion of intergovernmental collaborative platforms as a means of coordinating and harmonizing policies, legislation and actions pertaining to the environment. In other words, NEMA provides the basis for an integrative approach to decision-making which is centred on principles of environmental sustainability as well as fairness, equity and inclusivity. In relation to climate and human-induced coastal risk, NEMA identifies particular environments such as the coastal zone as sensitive, vulnerable, dynamic and highly stressed, thus requiring particular attention in respect to management and planning considering the extent of human pressure (*National Environmental Management Act, No. 107 of 1998*, 1998: s2). Considering the nature of the coastal environment, NEMA recognises it as a "special environmental management area", hence giving rise to the Integrated Coastal Management Act No. 24 of 2008.

4.5. National Environmental Management: Integrated Coastal Management Act No. 24 of 2008

Integrated coastal management (ICM) is a globally adopted approach for addressing complex coastal problems in a holistic and integrative manner. South Africa is one of the developing nations that adopted and implemented this approach to managing and developing the coastal environment. Historically, the transition from a predominately conservation focused and technocratic approach to ICM, to one that is more integrated and participatory in nature and driven by concerns about human-environmental interactions and sustainable development, culminated in the promulgation of the Integrated Coastal Management Act of 2008 (ICM Act) (Sowman & Malan, 2018; Glavovic, 2016; Chevalier, 2015). The ICM Act provides the necessary shift towards a more participatory and adaptive management approach which seeks to integrate policies and actions across scale as well as recognise the interlinkages between environmental processes and human activities (Sowman & Malan, 2018; Glavovic, 2016; Goble et al., 2014). According to Colenbrander & Sowman (2015), given this reformed paradigm for understanding human-coastal interactions, the ICM Act is considered one of the most progressive frameworks for coastal governance.

Considering external pressures such as climate induced sea level rise and increased human development impacting the coastal zone, ICM is increasingly being framed within the coastal risk governance discourse (Chevalier, 2015; Colenbrander & Sowman, 2015). As a governance framework, the ICM Act has yielded major progress in consensus building through promoting meaningful public participation as well as collaboration across national, provincial and municipal levels. As a result, Sowman & Malan (2018) and Glavovic (2006) are of the view that given its progressive nature, the ICM Act presents itself as a practical model for transformative governance. Glavovic (2016) highlights the importance of authentic stakeholder and community engagement as an important part of the governance process. Goble et al. (2014) reinforces this point, stating that the responsibility for the management, protection and enhancement of the coastal zone rests with all organs of state as well as non-state actors, hence the importance of collaborative engagement.

At a national level, the ICM Act seeks to promote ecologically, socially and environmentally sustainable coastal development. In the case of external pressures affecting the coastal zone such as sea level rise and associated risks, the ICM Act responds through affirming the purpose of coastal public property as securing the functioning of dynamic coastal processes. On the other hand, the ICM Act protects people, property and economic activities from the risks arising from coastal processes through declaring coastal management lines and coastal protection zones (*Integrated Coastal Management Act, No. 24 of 2008,* 2008: chap2). As an example of this, the legal identification of a high-water mark by the ICM Act ensures that local communities are protected from the risk of property damage and loss of

lives due to external climate induced coastal risks such as sea level rise (Goble et al., 2013; *Integrated Coastal Management Act, No. 24 of 2008,* 2008: chap2, s14).

At the same time, chapter 2, section 15 makes reference to responding to erosion and accretion. It notes that;

"no person may physically respond to erosion or accession on coastal public property by constructing, maintaining or extending any structure, or take any other measures to prevent or promote erosion or accretion of the seashore in respect to coastal public property, except in accordance with the ICM Act, NEMA or other Specific Environmental Management Acts (SEMA's)"

The ICM Act further notes that "*no person may compel the State, or other person to take such action, unless the erosion is caused by an intentional act"* (*Integrated Coastal Management Act, No. 24 of 2008*, 2008: s4).

Considering that coastal erosion is partially a natural occurrence, this means that private owners may not take action to address erosion. However, the ICM Act makes provision for establishing coastal management lines. The establishment of these lines, which will be further discussed later in this chapter, seek to further legally reinforce the protection of natural and socioeconomic interests associated with the coast from external risks (*Integrated Coastal Management Act, No. 24 of 2008*, 2008: chap2, s25).

The ICM Act places great emphasis on collaborative and shared management responses and mandates by all sectors and spheres of government which is evident by the establishment of institutional mechanisms such as coastal committees and coastal management programmes (Sowman & Malan, 2018; Goble et al., 2014). In order to comply with the national ICM guidelines and ensure their effective implementation, coastal committees need to be established and coastal management programmes must be developed at national, provincial and municipal levels. As outlined in the ICM Act, coastal committees, which are established at national, provincial and municipal levels, promote effective cooperative governance and coordination across different spheres of government and between state and non-state actors in order to facilitate platforms for dialogue regarding integrated coastal management (*Integrated Coastal Management Act, No. 24 of 2008*, 2008: chap5, s35).

Another institutional response to addressing coastal issues as outlined in the ICM Act are the development of coastal management programmes (CMPs). CMPs, which are carried out at national, provincial and municipal level, are policy directives or strategies that guide decision-making to adhere to requirements in the ICM Act (Sowman & Malan, 2018; Western Cape Coastal Management Programme, 2016). These programmes provide a desired vision for sustainable and integrated coastal

management through providing a framework for cooperative governance in achieving these desired visions. In order to attain the desired visions for coastal management, the National Coastal Management Programme of 2014 (NCMP), which is centred upon 9 priority areas, is implemented at the national, provincial as well as municipal level. The priority areas of relevance to coastal risk governance are as follows; priority 1 refers to effective planning for coastal vulnerability to global change which includes climate change, priority 5 refers to the establishment of coastal monitoring and reporting systems to inform decision-making and priority 6 requires the establishment of mechanisms for effective compliance and enforcement which includes coastal management progress and status reporting. In addition, priority 8 which refers to the strengthening of awareness, education and training, builds capacity in order to foster collective responsibility for the management of the coast. Priority 9 emphasises the importance of strengthening stakeholder partnerships through collaborative, problem-solving and consensus building measures in relation to integrated coastal management (National Coastal Management Program, 2014).

The National Coastal Vulnerability Assessment (NCVA) is a flagship programme driven by the National Department of Environmental Affairs in partnership with the Centre for Scientific and Industrial Research (CSIR) which seeks to identify coastal hotspots along the South African coast at-risk considering projected sea level rise and associated climate induced impacts. These impacts would include coastal erosion and flooding vulnerability. The assessment was initiated from the need to provide uniformity on how to drive efforts of rehabilitate and restore the coast in response to coastal risks at the national, provincial and municipal level. The NCVA would develop the necessary information for decision-makers particularly at local government level in implementing various outputs from the National Coastal Management Programme in responding to climate-induced risks and impacts. The assessment would also provide the necessary insight to be used by the insurance industry. However, the NCVA is currently in its last stages of development and not yet available to the public, thus the information provided here are as per communication with governmental officials at national and provincial level (NG1; PG1; PG2, March 2019).

At a provincial level, each province is mandated to develop a coastal management programme which includes the Western Cape. Provincial Coastal Management Programmes (PCMPs) promote institutional innovation for coastal governance, economic development and sustainable planning of coastal settlements. At the same time, they provide the necessary guidelines for building resilience to the effects of coastal hazards and associated impacts and developing capacity through public awareness and dialogue at the provincial but more so municipal level (Western Cape Coastal Management Programme, 2016). Since 2016, coastal committees have been established for all coastal provinces. Their main role is to create platforms for discussions and knowledge sharing relating to problems affecting the coast and making recommendations (Sowman & Malan, 2018). Glavovic (2016) state that

the Western Cape has made great strides in institutionalising the provisions of the Act and for building capacity amongst local officials and non-state actors.
In terms of coastal risk, a central measure developed in responding thereto is coastal management lines (CMLs), previously referred to as setback lines. According to the Department of Environmental Affairs (2017), coastal management lines (CMLs) are developed to prohibit or control development along the coastal zone in order to avoid risks associated with coastal processes such as flooding, storm surges and erosion from affecting property, human life and social and economic growth. Goble & MacKay (2013) reinforce that demarcating CMLs are a legislative requirement of the ICM Act.

Section 25, chapter 2 of the ICM Amended Act (2014) makes provisions for the establishment of coastal management lines with the intention to protect and preserve:

"*coastal public property such as beach amenities and other infrastructure such as parking; coastal private property such as private residences and business properties; public safety in the face of extreme weather and other natural events; the coastal protection zone i.e. the continuous strip of land, starting from the high-water mark and extending inland for a default distance, either 100 m or 1000 m which could include specific sensitive features; and the aesthetics or 'sense-of-place' of the coastal zone."*

Essentially, CMLs have the potential to protect coastal infrastructure as well as local communities from extreme natural events by promoting a managed retreat approach for areas susceptible to coastal risks (Sowman & Malan, 2018; DEA, 2017; Goble & MacKay, 2013). In ensuring the effectiveness of CMLs, the *National Guideline Towards the Establishment of Coastal Management Lines* has been developed to provide guidance to coastal provinces in preparing their Spatial Development Frameworks (SDFs) and Land Use Schemes at the provincial and municipal level.

As emphasized by the ICM Act and echoed by the Provincial Coastal Management Programme (PCMP), public participation across all spheres of government including the public, parastatals and specialists, is a vital component for the successful implementation of CMLs. Given the complex nature of coastal risk, numerous considerations ought to be considered prior to the approval of CMLs such as the legal parameters (i.e. national, provincial legislation and local by-laws), physical factors (e.g. coastal hazards such as erosion, flooding and storm surges), social (e.g. coastal access) and economic factors (e.g. ecotourism taking place in close proximity to the coast) (Department of Environment Affairs, 2017).

In further understanding the effective implementation of coastal management lines in response to coastal risk, it is necessary to consider the provisions within the Spatial Planning and Land Use Management Act (SPLUMA) that are relevant to coastal risk. SPLUMA provides

"*a uniform, effective and comprehensive system of spatial planning and land use management; ensures that the system of spatial planning and land use management promotes social and economic inclusion; provides for sustainable and efficient use of land; provides for cooperative governance and intergovernmental relations amongst national, provincial and local spheres of government"* (*Spatial Planning and Land Use Management Act No. 16 of 2013*, 2013, chap1, s3).

SPLUMA, in relation to the *National Guideline Towards the Establishment of Coastal Management Line* (see section 25 of ICM Act), provides the necessary guidelines for spatial planning and land use management through planning and development decisions across all spheres of government.

The SPLUMA advocates for environmentally sustainable spatial planning and achieves this through the inclusion of environmental sector plans and policies in Spatial Development Frameworks (SDFs) at national, provincial as well as municipal levels. The SDF identifies long-term risks relating to spatial patterns of growth especially along coastal areas and proposes strategies such as coastal management lines to mitigate the risks associated with inappropriate spatial planning (*Spatial Planning and Land Use Management Act No. 16 of 2013*, 2013: chap4, s12). In terms of departmental mandates, at the national level, spatial planning falls under the jurisdiction of the Department of Rural Development and Land Reform (DRDLR) as well as the Department of Planning, Monitoring and Evaluation (DPME), given their joint collaboration in the development and implementation of the National Spatial Development Framework (NSDF) (Department of Planning, Monitoring and Evaluation, 2018).

Provincially, the Department of Environmental Affairs and Developing Planning administers spatial planning and development and the implementation of the Provincial Spatial Development Framework (PSDF) (Western Cape Provincial Spatial Development Framework, 2014). The Spatial Planning Department mandates at the municipal level differs from one municipality to the other. For instance, in the case of the Saldanha Bay Municipality (SBM), the spatial planning mandate forms the responsibility of the town planning department. SPLUMA makes a provision for environmental management spatial tools and policies to be taken into account during the process of compiling provincial and municipal spatial plans. Similarly, the ICM Act provides provincial and municipal authorities the jurisdiction to establish zoning schemes where and when necessary.

In terms of governance, SPLUMA outlines that
"*all spheres of government should ensure that an integrated approach to land use and development is taken that is guided by spatial planning and land use planning; all government departments must provide their sector input and comply with prescribed requirements when preparing or amending spatial development frameworks; the preparation or amendment of spatial plans, policies as well as*

development applications, include transparent processes of public participation; and policies, legislation and procedures must be clearly set in order to inform and empower members of the public" (Spatial Planning and Land Use Management Act No. 16 of 2013, 2013: chap2, s7).

Similarly, chapter 3 (section 9) of SPLUMA, makes mention that national government must support and assist the province and local government in the performance of land use management and spatial planning, monitoring the quality and effectiveness of municipal SDFs and overall, the capacity of provinces and municipalities to implement the Act. Sowman & Malan (2018) are of the view that the progressiveness of the ICM Act stems from the various mechanism implemented, mentioned above, to improve public input and collaboration regarding issues relating to the coastal environment. In truth, ICM Act has several provisions to address inappropriate coastal development and risks but falls short due to weak implementation.

4.6. Disaster Management Act No. 67 of 2002

The Disaster Management Act No. 67 of 2002 (DMA) manages South Africa's dynamic natural environments, which would include the protection of the coastal zone from disasters. Historically, the approach to disaster management emerged from the Civil Protection Act no. 67 of 1977 which was reactive and focused solely on post-disaster measures and addressing the consequences thereof. However, given the devastating effects of the 1994 Cape Flats floods, particularly in poor communities, the reactive nature of the DMA came into question and the need for an holistic and integrated approach to disaster management emerged (van Niekerk, 2007).

Van Nierkerk (2006) argues that the need for a new approach to disaster management gave rise to the Green Paper on Disaster Management in 1998, the White Paper in 1999, the publication of the Disaster Management Bill in the early 2000's and finally the promulgation of the Disaster Management Act in 2002. Scholars have argued that the DMA provides and new era for addressing disaster risk, hazards and vulnerability through the establishment of structures, frameworks and plans that cross cut all government spheres and is driven by a holistic approach in relation to cooperative governance (Roth & Becker, 2011; van Riet, 2009; van Niekerk, 2006; van Niekerk, 2005).

A central aim to the DMA is to reduce, prevent and/or mitigate risks associated with disasters, and its severity through rapid and effective responses as well as post-disaster recovery (*Disaster Management Act, No. 67 of 2002, 2002*). The DMA provided a shift in thinking from the traditional disaster response to one of disaster risk reduction, prevention and mitigation (van Niekerk, 2014; van Riet, 2009; van Niekerk, 2005).

The Disaster Management Act recognizes various opportunities to avoid and reduce disaster losses by acknowledging the need for a uniform and inclusive approach through the efforts of numerous spheres of government, the private sector and civil society. The National Disaster Management Framework (NDMF) acts as a legal instrument established by the DMA to ensure consistency across multiple interest groups in relation to disaster management. Van Niekerk (2014) and Van Niekerk (2005) point out that the DMA provides guidance on the nature of and approach to disaster risk management in South Africa, whereas the NDMF outlines how the objectives of the DMA can be attained. The Framework provides coherence, transparency and inclusive disaster management by recognising the importance of cooperation and specifies mechanisms for achieving this (National Disaster Management Framework, 2014). One of the key performance areas (KPA) of the NDMF which will be highlighted for the benefit of this project is the establishment of institutional authorities for the implementation of disaster management within national, provincial and municipal spheres of government.

KPA one focuses on the application of cooperative governance in terms of disaster management. In doing so, it stresses the involvement of all stakeholders in strengthening the capabilities of state and non-state actors in reducing the impact of disasters. As identified by the NDMF, numerous institutional measures have been established in realizing cooperative disaster risk management. These include the Intergovernmental Committee for Disaster Management, the establishment of disaster management centres as well as advisory forums which are established at the national, provincial as well as municipal level. Van Niekerk (2006) argues that the national disaster management centres are the most fundamental element of the DMA as they provide the first steps to operationalizing coordinated and integrated disaster risk management in South African. Provincial Disaster Management Centres are obligated to build disaster management institutional capacity for the respective province as well as ensure that cooperative governance is implemented both inter-governmentally and interdepartmentally thus feeding into integrated developed planning (van Niekerk, 2007; National Disaster Management Framework, 2005). In particular, the municipal disaster management advisory forum is of critical importance. The literature stresses that local municipalities are at the forefront of disaster events, hence the disaster management advisory forum plays a vital role pre-disaster but more so during post disaster rehabilitation (Roth & Becker, 2011; van Riet, 2009; van Niekerk, 2007).

In line with the DMA, the provincial disaster management framework refers to expected climate change impacts and risks associated to specific identified areas and provide for context appropriate prevention and mitigation strategies (van Niekerk, 2007; van Niekerk, 2005; *Disaster Management Act, No. 67 of 2002*, 2002: chap4). Here the DMA refers to risks associated with particular contexts which would include the coastal zone (i.e. coastal risk). Provincially, the Western Cape Disaster Management Framework (WCDMF) makes clear reference to coastal flooding and storm surge as one of the major hydro-meteorological risks affecting the province. Given the coastal environment being at the forefront

of disasters, the WCDMF in line with the DMA explicitly outlines the immediate responses post-disaster at a municipal level as being assisting and protecting the public, protecting property and dealing with the destructive and other effects of the disaster (*Disaster Management Act, No. 67 of 2002*, 2002: chap5).

Another crucial element of the DMA at the local municipal scale is the Integrated Development Plan (IDP). The IDP is a principal strategic planning mechanism that guides and informs all development planning, disaster management and decision-making at the municipal level (van Nierkerk, 2006: 114). According to van Riet (2009) and van Niekerk (2006), the association between disaster management and the IDP enshrines the principle of disaster management into all municipal projects and strategies.

Considering coastal risk, the disaster management framework in conjunction with the DMA captures its complexity through encouraging collaborative and informed interaction across various governance actors at both the pre-disaster planning as well as post-disaster response stage (van Riet, 2009; van Niekerk, 2005). This approach is most important at a municipal scale given mandate uncertainties, financial constraints and limited personnel capabilities.

4.7. Climate Change Bill of 2018

The Climate Change Bill, which is currently in its draft form, seeks to provide an overarching legislative framework for addressing and responding to climate change.

The Bill promotes "*coordinated and integrated responses to climate change and its associated impacts by all spheres of government in accordance with the principles of cooperative governance"* (*Draft Climate Change Bill*, 2018: chap1, s2).

The Bill advocates for a coordinated and integrated approach to addressing climate change impacts through engaging actors across government scales.

The Bill further states that through effective and collaborative management responses, it aims to "*enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change, with a view of building overall social, economic, and environmental resilience"* (*Draft Climate Change Bill*, 2018: chap1, s2).

As a means of applying these provisions to a provincial and municipal scale, the Bill places great emphasis on institutional arrangements at a provincial and municipal level. According to chapter 2 section 8, the Bill refers to the establishment of provincial committees on climate change which would comprise of various relevant departments and municipal officials.

Chapter 3 section 9 subsection 5 of the (Draft) Climate Change Bill goes further requiring "*a provincial or municipal climate change response implementation plan to be integrated"* which is a vital element in addressing the complexity of climate change.

At a municipal scale, as outlined in chapter 3, section 9, subsection 1, the Bill stresses the importance of a climate change needs and response assessment which must be reviewed at least once every five years. As per chapter 3 section 9 subsection 2, climate change response implementation plans must be informed and developed based on this assessment. Furthermore, this implementation plan must include adaptation as well as mitigation plans based on the identification and analysis of local areas or communities at risk and the particular responses appropriate to the given context. It is clearly seen that the Bill is underpinned by principles requiring cross scale collaboration as it advocates for integrated responses centred upon holistic thinking. Despite, the Bill not explicitly mentioning measures to address climate-induced risk and associated impacts, it does set out clear principles based on collaborative and cross-disciplinary decision-making to development planning and implementation in response thereto.

4.7.1. National Climate Change Adaptation Strategy of 2019

As introduced by chapter 4 of the Climate Change Bill of 2018, a draft National Climate Change Adaptation Strategy (NCCAS) has been developed and circulated for public comment (May 2019). As a means of advancing South Africa's commitment to international and national climate change adaptation measures, the Strategy provides the necessary guidance to government actors across national, provincial and municipal scale as well as stakeholders affected by climate change and variability. The strategy facilitates greater coherence and coordination between various stakeholders in strengthening climate resilience (National Climate Change Adaptation Strategy, 2019).

The NCCAS identifies the coastal zone as one of the key vulnerable socio-economic sectors and environments given increased land use change, coastal flooding and erosion. In building greater adaptive capacity in relation to coastal risk, the NCCAS seeks to integrate the national disaster risk management framework into climate change preparedness, response and recovery. The strategy also calls for the inclusion and strengthening of adaptive capacity and resilience to climate change into national, provincial and municipal disaster management plans.

The NCCAS seeks "*to identify individuals and communities at most risk from climate change within local municipalities and deliver context specific climate change vulnerability reduction programmes"* (National Climate Change Adaptation Strategy, 2019: 23).

In light of the identified at-risk areas, the strategy develops resilience-building strategies and projects centred upon social learning with a view to minimizing the extent of risk. These strategies could be

used as a template for replication in similar contexts (National Climate Change Adaptation Strategy, 2019). The identification of these at-risk areas provides guidance on context appropriate responses to climate-related risks such as flooding due to major storm events which is a major problem along South Africa's coasts. In the case of coastal risk, this would include at risk properties and infrastructure along the coast.

Apart from integrating climate change adaptation planning into provincial and municipal development planning, the NCCAS encourages capacity building and training of staff in managing infrastructure considering current and predicted future climate change risks and associated impacts (National Climate Change Adaptation Strategy, 2019). At the local municipal scale, the training of government officials in monitoring is vital to developing technical capacity in building greater unified climate risk insight and response strategies. Considering the extent of environmental impact along the coastal zone and its vulnerability to risk, monitoring of climatic change forms the basis for appropriate response measures. The establishment of provincial and municipal committees on climate change, as outlined by the NCCSA, provides the platform for enhancing robust public-private-civil society collaboration through resilience building projects as well as fostering stakeholder knowledge sharing. This, in turn, would provide greater contextual insight to the challenges at hand and how to improve greater cross-scale collaborative efforts in response thereto as well as illustrate and stress the complexity associated with coastal risk.

In line with the Climate Change Bill, the NCCAS provides the necessary guiding principles of collaboration "*by organs of state in all spheres of government, and where relevant should also include non-governmental organisations, the private sector and local communities"* in order to build greater resilience and adaptability in areas most prone to risk, including coastal risk (*Draft Climate Change Bill*, 2018: chap4, s10).

4.8. The Green Book

The Green Book is an online support tool which guides municipal planning in developing climate resilient settlements (CSIR, 2019). The online tool was developed in 2019 by the Centre for Scientific and Industrial Research (CSIR) and co-funded by the International Development Research Centre (IDRC) and partnered by the National Disaster Management Centre and other research and governmental organisations. The Green Book aims to mainstream local climate change adaptation into local municipal government planning and enable effective forward-thinking. In doing so, the tool provides comprehensive scientific evidence on the likely risks faced by all municipalities in the country as part of a municipal risk profile as well as the necessary adaptation actions in response thereto.

The municipal risk profile identifies socio-economic vulnerability of settlements and neighbourhoods and its expected development trajectories under a medium and high population growth scenario. In addition, it identifies the changes anticipated in the climate for both high and low mitigation scenario and the impacts of hydro-meteorological hazards on these settlements given development trajectories (Le Roux et al., 2019). It *"combines the scientific information from the story maps per municipality and precedes the adaptation actions tool by providing risk factors that can be used to prioritise adaptation actions"* (Le Roux et al., 2019).

The Green Book acts as a complimentary adaptation tool which provides "*a range of planning and design actions that can be taken by local government to adapt to the impacts of climate change, reduce exposure to hazards, and exploit opportunities for sustainable development" (*Van Niekerk et al., 2019).

Furthermore, the Green Book ensures that each adaptation action is "*linked to the mandate of local government; that it is suitable for urban areas; that it is associated with local planning functions; linked to good planning principles; aligned with mitigation where appropriate and provide an economic, social and or environmental benefit no matter the level of climate change"* (Van Niekerk et al., 2019).

These adaption actions, at the municipal level, are directed at spatial planning monitoring, land use management control, landscape design, environmental planning and engineering services. In relation to coastal risk, the Green Book, which categorises climate risks as heat stress, increased wind speed, drought, groundwater depletion and surface water depletion, includes coastal and inland flooding.

As illustrated, South Africa has very environmentally sound policies, laws and plans to address coastal risk. In theory, these legislative frameworks are centred upon collaborative, cross-scale and holistic thinking and action. However, in reality, its realisation is constrained by poor implementation capacity, particularly at the local governmental level.

4.9. Local government policies, plans and programmes in response to coastal risk in the Saldanha Bay Municipality

This section looks at the local level policies and plans in response to coastal risk within the context of the Saldanha Bay Municipality (SBM).

4.9.1. Saldanha Bay Local Municipality Coastal Management Programme 2019 – 2024

The adoption of a Saldanha Bay Local Municipality Coastal Management Programme (SBLM CMP) is centred upon an integrated approach which feeds into the larger West Coast District Municipal Coastal Management Programme (WCDM CMP).

As a participatory process, the Saldanha Bay Local Municipality Coastal Management Programme (SBLM CMP), which was informed through collaborative engagement and discussion, was developed and recently updated. The objective of the SBLM CMP is based on achieving the municipality's vision for effective yet sustainable coastal management. As part of this objective, 10 themes, based on importance, have been identified as implementation strategies for coastal management within the municipality. Considering the scope of this project, selected themes from the SBLM CMP will be reviewed as they relate to coastal risk, in particular. The themes which will be reviewed are, theme 1 cooperative governance & institutional arrangements, theme 3 coastal planning and development and theme 10 which relates to awareness, education, training, capacity building and information (Saldanha Bay Local Municipality Coastal Management Program, 2019)

Theme 1, as noted in the SBLM CMP (2019), acts as a focal point for effectively implementing the objectives of the CMP. It provides the overarching framework for improving as well as building cross-scale, cross-sector and cross-disciplinary collaboration. The CMP identifies both internal environmental and coastal management roles played by various units at a provincial, district and local level and stresses the importance of also relying upon external stakeholders which would have an indirect role therein.
In terms of the challenge of under capacitated local municipalities, as in the case of the WCDM and SBM, the CMP highlights the need for greater support from the WCDM, provincial and national environmental departments. Improved cooperation between relevant government spheres and public-private partnerships is also needed as well as defining a clear mandate for all spheres of government. These measures act as ways of facilitating and improving institutional arrangements and cooperative governance in response to coastal management within the municipality.

In light of increased development along the coast and with Langebaan being an ideal example thereof, the need for sustainable and equitable development is crucial as promoted by theme 3. A number of spatial planning tools have been highlighted by the SBLM CMP in aiding decision-makers in making informed and sustainable decisions in terms of coastal development. One of the tools included in the Saldanha Bay Integrated Development Plan is Coastal Management lines (CMLs) that seek "*to protect coastal public property and private property; contribute to public safety; determine features that should be protected under the coastal protection zone; and preserve the aesthetic values of the coastal zone"* (Saldanha Bay Local Municipality Coastal Management Programme, 2019: s3, ss4).

CMLs are informed by environmental buffers (i.e. maintaining a functional coastal ecosystem), social buffers (i.e. by allowing for public beach access through and along the coastal frontage) and economic factors which would allow for new beach facilities. The overlay zones, which is a universal mechanism for the planning and administration of CMLs is subject to short term (1:20 year), medium term (1:50 year) and long-term (1:100 year) scenarios which result from coastal processes such as erosion and

storm surges. However, CMLs are currently in the process of development, therefore the SBM has not yet incorporated the CMLs into their municipal planning process.

The CMP highlights, "*impacts of climate change, such as sea level rise and coastal erosion due to storm surges and inundation, need to be considered prior to approving applications for new development within the coastal zone; Coastal Management Lines must be incorporated into the SDFs (once they have been approved by the MEC), but must in any event be considered in all coastal plans and proposed coastal developments and finally erosion control measures must be implemented along sections of the beaches in the SBLM"* (Saldanha Bay Local Municipality Coastal Management Programme, 2019: s3, ss4).

This speaks to the importance of integrated resilience planning in response to external threats such as climate change and associate impacts in relation to spatial development, which is to be improved upon in the SBM.

Of critical importance in promoting effective coastal management is awareness through education, training and capacity building amongst stakeholders. Theme 10 "*facilitates knowledge production and exchange, the promotion of knowledge sharing of coastal issues, and instilling a sense of ownership of the coastal zone"* (Saldanha Bay Local Municipality Coastal Management Programme, 2019: s3, ss11). Numerous coastal information platforms have been introduced to increase local awareness. These platforms are the National Ocean and Coast Information System and particularly the coastal flood hazard decision support tool which identifies coastal areas at risk of flooding and assists in facilitating climate change adaptation. Indeed, the CMP states that the WCDM and SBM should invest greatly in improving awareness, training and capacity building which would count in their favour in terms of improving coastal management, if carried out sustainably and collaboratively.

4.9.2. Saldanha Bay Municipality Spatial Development Framework (SBM SDF) 2019

The recently developed Spatial Development Framework (SDF) provides a framework that guides spatial planning of existing and desired land uses within a municipality in line with the goals of the Integrated Development Plan (IDP).

"The IDP seeks to support sustainable development of the municipal area and its communities through integration and balancing of the economic, ecological and social factors which influence development … without compromising the institutional capacity required to implement and coordinate the actions required across different sectors and spheres of government" (Saldanha Bay Municipality Integrated Development Plan, 2019: 10).

The SBM SDF identifies six strategic goals in achieving the goals of the IDP. With reference to coastal risk along Langebaan shoreline, the following goals have direct and or indirect relevance.

Goal three seeks "*to provide an environmentally and economically sustainable bulk service infrastructure and road transport network";* goal five, "*to promote the conservation and sustainable use of natural resources in the Saldanha Bay Municipality"* and goal six which aims "*to ensure that ongoing development pressure and its spatial implications are managed in a sustainable manner that protects the unique character of the existing cultural landscape and the place-specific character and form of the existing settlement pattern"* (Saldanha Bay Municipality Spatial Development Framework, 2019: s6, ss1).

In seeking to provide an environmentally and economically sustainable bulk service infrastructure and road transport network, in term of coastal risk, goal three "*ascertains the overall carrying capacity of existing bulk services related to existing and future growth and where appropriate consider risk zones"* (Saldanha Bay Municipality Spatial Development Framework, 2019: s6, ss1).

This objective amplifies the need to consider risk zones into future municipal planning given current and future urban growth, which would feed into coastal management policies as well as spatial planning models.

In relation to the Langebaan case study and with particular reference to attaining sustainable use of natural resources within the municipality, as encouraged by goal five the following relevant objectives are identified:
"ensuring that the impact of existing and proposed development is adequately evaluated from a holistic environmental perspective; to limit and control development and activities within environmentally sensitive and / or conservation worthy areas so as to ensure their sustainability taking into account effects on biodiversity; to address the rehabilitation of degraded or disturbed environments" (Saldanha Bay Municipality Spatial Development Framework, 2019: s6, ss1).

These objectives highlight the importance of holistic thinking in spatial planning and development, especially when development would potentially infringe upon the natural characteristics of an area, as in the case of Langebaan. These objectives, as per the SDF, limits and or controls urban development. At the same time, the SDF speaks to the need for rehabilitating Langebaan's coastal dune system affected by coastal development.

With relevance to coastal risk and in line with goal six, the following objective is identified:

*"to determine clear limits to urban development and define the urban edge / limits of existing settlements" (*Saldanha Bay Municipality Spatial Development Framework, 2019: s6, ss1*).*

In addition, as previously outlined by goal five, this objective echoes the need to relook at spatial planning and development along the urban edges. It further supports the need to clearly identify the limits to development within a municipal area considering the ecological impacts such as dune loss given increased coastal development as well as external impacts posed by climate induced change such as sea level rise on coastal property. In light of this, a SBM town planner explained, "*any coastal development [within the municipality] is subject to an EIA which will be able to pick up risk zones … therefore the EIA and town planning application run hand in hand [as] the EIA informs town planning applications"* (LG3, March 2019). He further added, "*the environment was always a separate issue [to town planning] but now it's integrated. … [spatial planning is] moving in the right direction as no more insensitive development [takes place]"* (LG3, March 2019). However, a SBM environmental officer argued, *"local policies [such as the IDP and SDF which are based on a five-year plan and then reviewed] are not aligned with long-term planning, [therefore] the SBM lack a grand plan for long-term planning" (LG2, March 2019).*

4.9.3. SBM SDF – Langebaan Spatial Development Proposals

In terms of spatial analysis for the town of Langebaan, it is noted that "*much of the coastal strip is built on the fore dune and is vulnerable to erosion and sea level rise"* (Saldanha Bay Municipality Spatial Development Framework, 2019: s6, ss4).

Considering the extent of coastal risk along the Langebaan shoreline, the SDF seeks to "*prohibit or restrict erection, alteration or extension of buildings and structures wholly or partially seaward of the Coastal Management Line*. At the same time, it states that *all development is to be set back behind coastal management lines"* (Saldanha Bay Municipality Spatial Development Framework, 2019: s6, ss4).

However, as stated by a SBM environmental officer, *"the challenge [remains] of retrofitting and managing old Apartheid planning and development especially along the Langebaan coast [as] these plans were approved before environmental legislation"* (LG2, March 2019). Although currently in its final stages of development, the challenge of the coastal management lines lies in its implementation considering outdated Apartheid-era spatial planning patterns, which is evident in the town of Langebaan.

Other policies, plans and programmes that have been identified by the interviewees to have direct or indirect relevance to addressing coastal risk along the Langebaan shoreline are outlined below. It should be noted that at the time of conducting the interviews in 2019 many of these tools were currently either

in the process of development, under public comment and or yet to be signed off by the relevant provincial officials.

4.9.4. Western Cape Provincial Coastal Management Line Project

The Western Cape Coastal Management Line Project, which is currently in its final stages of development, is driven by the provincial Department of Environmental Affairs and Development Planning (DEADP) in order to determine where and how development takes place in all municipalities in the Western Cape. According to provincial officials interviewed, the project seeks to review development rights in areas of high risk and determine context appropriate measures in these high-risk areas, which would include retreat, protection and/or adaptation action (PG1; PG2; PG3; DG1; LG3, March 2019). In terms of the goal of the coastal management line project, a provincial official outlined that, *"translating coastal management lines into planning legislation is important [in order] to value [and ensure the sustainable] development of coastal [risk] zones*" (PG3, March 2019). However, considering the prospect of this project, some government officials are doubtful. A district environmental officer noted, "*the coastal management lines [project] is make or break [as a response to local coastal risk [as] the implementation takes long [which is the problem]"* (DG1, March 2019). A coastal engineer stressed, *"[in terms of the coastal management line project] there is a need for a policy to deal with private properties under threat of coastal erosion [which is currently lacked therefrom]"* (EN2, August 2019).

4.9.5. West Coast District Municipality Disaster Risk Assessment 2012

The Disaster Risk Assessment seeks to assist district and local role-players to avoid, plan for, reduce and respond effectively and collaboratively to disaster risks in all municipalities within the district (West Coast District Municipality Disaster Risk Assessment, 2012). The West Coast District Municipality (WCDM) identified numerous disaster hazards within the district, one of which was shoreline erosion and flooding.

The assessment noted, "*risk reduction efforts should be targeted for sections of the coast that do not have natural defences and are vulnerable to storm surges. Particular consideration should be given to estuaries as water is funnelled up, raising the normal tide"* (West Coast District Municipality Disaster Risk Assessment, 2012: s2, ss1). This is evident in the Saldanha Bay.

In carrying out disaster risk management mandates, considering the challenges associated with the municipal disaster management division, a district disaster risk officer pointed out that poor communication is one of the major problems faced by the district, hence, there is "*a need for a more hands on approach with building relationships with other departments*" (DG2, March 2019). This speaks to the poor implementation and execution of responsibilities in response to disasters within the district. Evidently, a SBM fire chief pointed out, *"people still think that disaster management is the fire*

service's responsibility … disaster management is everyone's business" (LG4, March 2019). Certainty, this highlights the integrated nature of disaster management and the need for collective thinking in response to disasters.

4.9.6. West Coast District Municipality Risk Register 2012

As part of the WCDM Disaster Risk Assessment, a risk register has been developed. According to a WDCM Disaster Official, the register sets out and determines the level or priority of risk and also how to address it in all municipalities within the West Coast District, including the SBM (DG2, March 2019). The register noted that both coastal erosion and flooding in the district is tolerable, hence not a major priority. This explains the poor response by the WCDM and SBM to Langebaan's shoreline erosion issue. Storm surges, on the other hand, are ranked as the third highest priority of the district (West Coast District Municipality Disaster Risk Assessment, 2012).

4.9.7. Saldanha Bay Municipality Storm Water Master Plan

This plan sets out measures and interventions to better manage storm water in the municipality, particularly along the Langebaan shoreline. It also outlines how to reduce coastal risk and improve old storm water infrastructure causing erosion (LG3, March 2019). One of the measures introduced by the Storm Water Master Plan thus far has been retention ponds which reduces the amount of storm water outflow into the Bay (LG2; LG3, March 2019). This is a living document.

4.9.8. Saldanha Bay Municipality Integrated Zoning Scheme

The Saldanha Bay Municipality Integrated Zoning Scheme (SBM IZS) is a legal document which sets out what type of (development) activities can be undertaken within the municipal area and sets out the criteria for land use rights on properties (LG2; LG3, March 2019). The SBM is currently working on an integrated zoning scheme given the need for a new zoning scheme and precinct planning as part of the municipal Spatial Development Framework.

4.9.9. West Coast District Municipality Coastal Management Programme

The coastal management programme outlines the various measures and interventions required to effectively and sustainably manage the coastal areas of municipalities within the district, including the SBM (DG1, March 2019). This programme is not yet adopted as it is currently under review and public comment.

4.9.10. West Coast District Municipality Climate Change Response Framework 2014

This framework acts as a guide for governmental and non-governmental stakeholders to improve adaptive capacity in all municipalities within the West Coast District, including the SBM. The climate-

related risks identified by the framework include increased coastal flooding and inundation; increased erosion; deterioration of coastal defences; loss of private property and community assets and loss of beach width (Saldanha Bay Local Municipality Coastal Management Programme, 2019).

Mechanisms to address these risks include "*considering applications for new development in the coastal zone prior to its approval given the impact of sea level rise and coastal erosion as a result of storm surges and inundation; the incorporation of coastal management lines into the Spatial Development Framework (SDFs) once they have been approved by the MEC, which must be considered in all coastal plans and proposed coastal developments and ensuring that erosion control measures are implemented along sections of the beaches in the Saldanha Bay Municipality (SBM)"* (Saldanha Bay Local Municipality Coastal Management Programme,2019: s3, ss4).

Once again, it is evident that various policies, programmes, plans and guidelines to promoting coastal protection in respond to coastal risks exist. However, at the local government level, as in the case of the Saldanha Bay Municipality (SBM), the inability to effectively implement these legislatively required measures remain a major challenge.

4.10. Concluding remarks

The South African coast is dynamic and confronted with compounded climate and human-induced coastal risks. In order to effectively address and manage these risks, various policies, legislation, programmes and plans were developed at different levels of government as guiding tools. These policies, laws and plans that directly and or indirectly speaks to coastal risk, share a similar fundamental principle. This underpinning principle advocates for integrated, coordinated and holistic thinking and decision-making in developing proactive solutions to be mainstreamed and implemented at local government level in response to complex issues such as coastal risk. However, despite the plethora of policies and laws at these different levels of government, the institutional arrangements and capacity to execute these provisions seems to be lacking, particularly at the local government level.

Chapter 5

Contextual Background to the Langebaan case study

5.1. Introduction

Chapter 5 provides contextual background to the case study in relation to local climate and human-induced coastal processes. The chapter begins by highlighting the complex nature of the South African coast then hone in on the Western Cape coastline by identifying its social, economic and ecological characteristics as well as the climate-induced coastal risks experienced. The chapter then provides contextual background of Langebaan in relation to coastal risk.

5.2. The South African coast

The South African coast is one of the most biological diverse in the world and extends for 3000km. Approximately one-third of the South African population resides 100km from the coast (SAIIA, 2015; Wigley, 2011). For the past 50 years sea level rise along the South African coast has been fluctuating between 0.42mm to 1.87mm per year (Umvoto Africa, 2011). Climate change is a major concern in South Africa and places its coastal areas at risk. The State of the Environment Report (2018) highlighted climate variability and change as one of the major threats to the South African coastline. Consequently, given that 80% of the South African coastline is characterised by sandy shores, coastal erosion is a major concern. Theron & Rossouw (2008) identifies the most vulnerable coastal areas in South Africa to the adverse effects of sea level rise based on scientific vulnerability indicators such as erosion and wave strength. These areas include Saldanha Bay, False Bay, Table Bay, Mossel Bay to Nature's Valley, Port Elizabeth and the KwaZulu-Natal coastline.

The Western Cape Province has the longest coastline in South Africa, extending for roughly 1500km (WCCMP, 2016). The coastline comprises of sandy beaches, rock outcrops, wetlands, estuaries and coastal lakes. The province's coastal areas are highly urbanized with 90.4% of its residents residing within these areas (Midgeley et al., 2015). Major developed coastal areas within the province are Saldanha Bay, Cape Town, Mossel Bay and Plettenberg Bay. The province's economic growth is centred around these major coastal centres, considering the extent of shipping, manufacturing, commercial fishing and or tourism taking place (State of Environment Report, 2018; DEAT, 2000). The State of the Environment Report (2018) identifies climate and human-induced impacts along the Western Cape coastline as being; habitat modification and dune disturbance as a result of coastal development, increased pressure from tourism, beach erosion and sea level rise. Based on climate change projections, the province is likely to experience more frequent and intense extreme weather

events, thus increasing the risk of coastal flooding and erosion (Midgeley et al., 2015). According to Davis-Reddy & Vincent (2017) sea level rise rates for the west and south coasts of the Western Cape has been estimated at 1.87mm and 1.48mm per year, between 1957 to 2006, respectfully, and projected to increase. Along the West coast, cut off coastal lows generate swell systems during spring highs and are responsible for high sea levels which, given projected regional sea level rise rates, is expected to increase in the coming decades (Umvoto Africa, 2011).

5.3. Langebaan: A coastal community at risk

5.3.1. The Saldanha Bay

Saldanha Bay is situated 100km north of Cape Town along the West Coast of the Western Cape. The Bay, which has a coastline spanning 238km falls under the jurisdiction of the Saldanha Bay Municipality (SBM) and under the broader West Coast District Municipality (WCDM). The municipality encompass the towns of Hopefield, Saldanha, Vredenburg, Jacobsbaai and Langebaan (Saldanha Bay Municipality IDP, 2017). The coastal town of Langebaan will be the focus of this study. Figure 3 identifies the geographical location of the Saldanha Bay and town of Langebaan in relation to Cape Town. Saldanha Bay is characterized as a complex human-environmental system given the various activities taking place within it. To the north is the Saldanha Bay Industrial Development Zone (SBIDZ) which is a local as well as national industrial growth point, and to the south is the ecologically significant West Coast National Park which is a RAMSAR site. Situated between these contrasting zones, is the town of Langebaan, a touristic centre for economic growth, as shown by figure 4.

Figure 3: Geographical positioning of the case study site (in yellow) in relation to Cape Town (in red) (source: Google Earth)

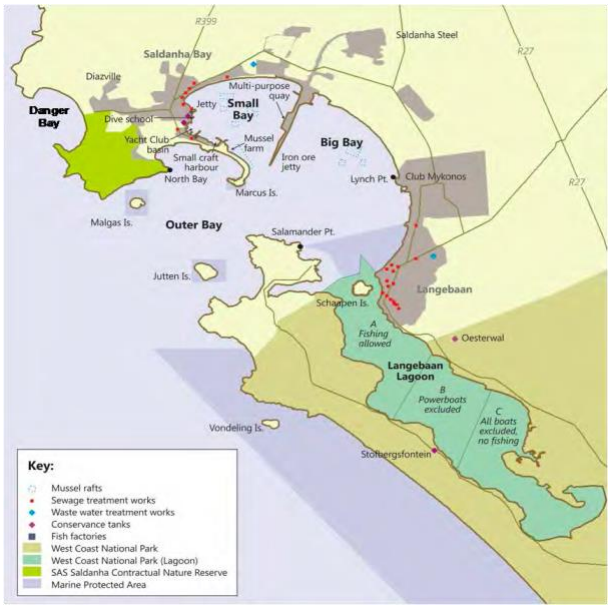

Figure 4: Map of the broader Saldanha Bay which highlights the contrasting socio-ecological makeup of the area (source: Clark et al., 2017)

5.3.2. The Langebaan Lagoon: A RAMSAR Site

Saldanha Bay is known for the Langebaan Lagoon. Geographically, the West Coast National Park (WCNP) falls within the West Coast District and Saldanha Bay Local Municipality with the town of Langebaan to the north of it (WCNP MP, 2013-2023).

The Langebaan Lagoon, which is characterised as a unique ecological system, comprises of a rich diversity of marine invertebrates and seaweed and supports approximately 10% of the coastal wader bird population in South Africa (WCNP MP, 2013-2023). The Lagoon also acts as a nursery for the development of juvenile fish. The islands surrounding the Lagoon provide the ideal nesting areas for red listed sea bird species. Given the unique and diverse biotic community, high levels of ecological productivity take place within its waters, as it is the only non-estuarine tidal sheltered lagoon in South Africa. (WCNP MP, 2013-2023; Schrijvers, 2000). In 1988 the Langebaan Lagoon and its surrounding islands were designated a RAMSAR site (WCNP MP, 2013-2023). The RAMSAR status recognises the Lagoon's ecological significance internationally.

In enforcing legislative compliance to the National Environmental Management Act (NEMA) and Marine Living Resources Act (MLRA), the WCNP introduced zoning areas which regulate human activities within and around the park. The Lagoon is divided into three distinct zones. Marine zone A or the controlled zone, which is the northern portion of the Lagoon, allows fishing and access for motorize vehicles, marine zone B or the sanctuary zone is access controlled with fishing and vehicle use allowed but only with a permit and marine zone C or the restricted zone, which is the southern portion of the Lagoon, is an exclusionary zone whereby fishing is prohibited (WCNP MP, 2013-2023).

5.3.3. The Saldanha Bay Industrial Development Zone (SBIDZ): A National and Local Industrial Growth Point

Over the last 50 years, industrial and economic development became synonymous with the Saldanha Bay. Industrial development in the Bay dates back to the early 20th century with the establishment of commercial fish and lobster industries. This was as a result of the area's diversity and abundance of fish (Clark et al., 2012). Industrialization within the Saldanha Bay was also due to the Bay having the largest natural deep port along the West Coast and one of the largest in South Africa (Clark et al., 2016).

A common site within Saldanha Bay is the iron ore jetty. The jetty was constructed between 1974 and 1976 and was one of the major development projects which took place in the Bay. This resulted in the construction of the Marcus Island Causeway. The causeway, which was constructed in 1973, linked the Saldanha mainland to the nearby Marcus Island as a means of sheltering ore ship carriers from incoming waves, as shown by figures 5,6 and 7 (Clark et al., 2011). In 1980, a multi-purpose terminal was added to the iron ore jetty and expanded upon in 1998, as illustrated by figure 7 (Clark et al., 2017). The jetty acts as a production site whereby the iron ore is mined and transported to being stockpiling at the terminal, loaded onto cargo ships and exported globally. Figures 5 and 6 illustrate the extent of port construction over a 30-year period within the Saldanha Bay. Due to these major industrial development projects, the Bay was divided into two smaller bays namely Small Bay and Big Bay, as shown by figure 7. It should be noted that given industrial development and expansion in the Saldanha Bay, numerous major dredging operations took place between 1974 and 2016 (Clark et al., 2018).

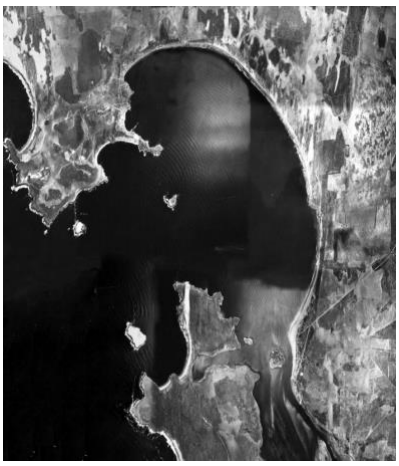

Figure 5: (left) Saldanha Bay prior to causeway construction in 1960 and figure 6: (right) post-construction in 1989 (source: Clark et al., 2012)

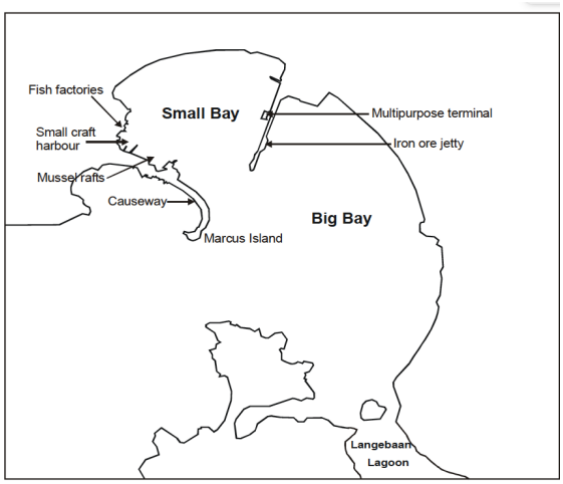

Figure 7: Major industrial developments within the Saldanha Bay between 1973 to 1984 (source: Clark et al., 2012)

In light of industrial expansion, the Bay was recognized as a strategically-important industrial centre for the Western Cape, hence the establishment of the Industrial Development Zone (IDZ) programme in 2013 (Clark et al., 2018). The Saldanha Bay IDZ was centred around the creation of an industrial complex bearing strategic economic advantages such as enabling strategic investment, the exploitation of a resource intensive industry, promoting integration with local industries, creation of employment and providing social benefits to the region (Clark et al., 2018). The proposed further development of the IDZ, as lead by national government and Transnet National Port Authority, would include improved shipping facilities as well as the further deepening and expansion of the existing port within the Bay (Clark et al., 2018).

5.3.4. Langebaan's at-risk shoreline

Langebaan is a small coastal town located 100km from Cape Town and lies adjacent to the West Coast National Park (WCNP), with the Saldanha Bay Industrial Development Zone to its north and Langebaan Lagoon to its south. The town is regarded as Saldanha Bay's acclaimed touristic and recreational centre (Clark et al., 2014). Langebaan emerged as a small fishing village and grew rapidly over the last few decades into a prominent coastal town (Clark et al., 2014).

The Langebaan shoreline is the most highly exposed area within the Saldanha Bay to climate and human-induced coastal risks such as flooding and erosion, hence its selection as case study (Louw & Rylands, 2012; Theron & Rossouw, 2008). McClarty et al. (2006) note that Langebaan beach has been suffering erosion for the past 30 years with 100m of shoreline being loss since the 1960's. The severity of the 1997 storm resulted in the loss of many residential properties and the need for immediate protective mitigation measures (Clark et al., 2012; Langebaan Beach Restoration Project Environmental Audit Report, 2012). Numerous reactive measures have been introduced to protect the shoreline and its coastal infrastructure and properties. These included rock revetments and temporary groynes. Numerous views exist to the cause of Langebaan's shoreline erosion, however, Flemming (2015) and

the Annual State of the Bay report identify the major human-induced cause of shoreline erosion as being the construction of the Marcus Island Causeway in 1973. Other causes include increased coastal development and changes in beach and dune morphology (Clark et al., 2013, 2011).

The construction of the Marcus Island causeway and iron ore jetty had a major impact on the Bay's tidal circulation. According to Louw & Rylands (2017), the state of tidal activity within the Bay is vital in understanding its vulnerability to risks such as erosion. Saldanha Bay is located within a micro-tidal environment and its wave action and velocity is highly influenced by wind direction (Krug, 1999). Krug (1999) notes that during spring tide water is funnelled up the Langebaan lagoon, raising normal tidal range levels to approximately two meters, thus increases wave strength and directly affecting the town of Langebaan.

The long-term effects of the Marcus Island causeway and iron ore jetty construction resulted in a third of the Saldanha Bay's mouth being reduced resulting in changing inflow wave dynamics, as identified in figures 8 and 9 (Clark et al., 2011; Krug, 1999). Prior to its construction, as shown in figure 8 (left), incoming waves could flow into the Bay on either side of the island with less force. However, after its construction, as highlighted in figure 8 (right), incoming waves are refracted inward around the island, thus entering the Bay with greater force. Incoming waves approach the Langebaan shore from a west to north-west direction given the reduced mouth of the Bay. It is evident by figure 8 (right) that at present, flood tides (i.e. water flowing inland), which are greater in intensity and further exacerbated by strong winds, are frequently occurring along the Langebaan shoreline. With reference to figure 9 and based on a study of the impact of port development on increased shoreline erosion rates, Flemming (2015) argues that dredging, as a mechanism for port expansion and beach replenishment within the Bay, is a major cause of increased coastal erosion due to high levels of sediment removal. Similarly, the extent of wave intensity is amplified due to maintenance dredging operation which took place close to Langebaan's south beach during the mid-2000's as part of beach replenishment (Clark et al., 2013; 2012). Consequently, dredging fuel increased wave energy, which in the case of Langebaan, increased to approximately 50% (Flemming, 2016 cited in Clark et al., 2014).

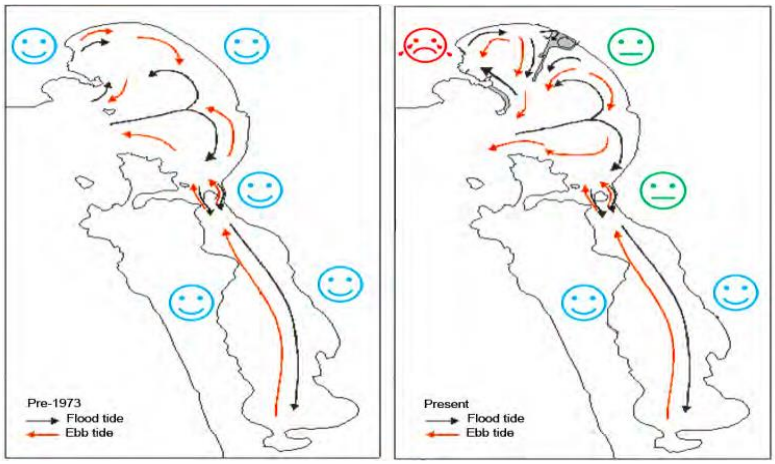

Figure 8: Changes in wave circulation prior to 1973 port development (left) and at present (right) (source: Clark et al., 2015)

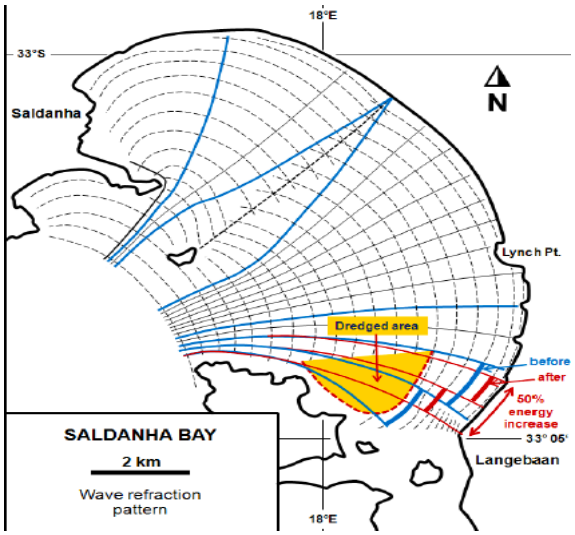

Figure 9: Wave refraction patterns in the Bay prior to the Marcus Island causeway construction (as shown in blue) and post-construction (as shown in red) with particular reference to Langebaan shoreline given dredging operation within its proximity. (source: Clark et al., 2016)

Increased coastal development is another human-induced cause of coastal risk along Langebaan shoreline. The town's touristic prominence is due to the presence of the Langebaan Lagoon and nearby holiday resorts (Saldanha Municipality SDF, 2017). Demographically, Langebaan's population growth between 2001 to 2011 stood at 9.24% per annum due to increase tourism and recreational activity (Clark et al., 2017). At present, much of the Langebaan coastal strip is built on the fore dune i.e. the area closest to the shoreline, with very little to no implementation of a coastal buffer zone, thus highly vulnerable to sea level rise and associated impacts.

Similarly, changes in beach and dune morphology is accelerated by increased coastal development. Due to the encroachment of development onto the Langebaan shoreline, increased flooding and erosion and associated property and infrastructure damage is common. These accelerated changes are intensified by the removal or degradation of coastal vegetation and sand dunes. Clark et al. (2014) and McClarty et

al. (2006) point out that shoreline erosion has been ongoing for the past 30 years given the cumulated human influences resulting in the loss of large sections of the shoreline. This is supported by a sediment study conducted by Gericke (2008) as cited in Clark et al. (2011), who concluded that the beaches within the Bay, one being Langebaan beach, has been changing significantly between 1988 and 2000.

Considering the vulnerability experienced along the Langebaan shoreline, this research identifies three sites along its shoreline in illustrating (a) the extent of risks experienced, (b) the measures which have been introduced in response to the risks and (c) the challenges associated with the responses taken at each site. These sites include the rock revetments at Langebaan North Beach (site 1), the temporary groynes or sand bags which are located at North Street Bay (site 2) and Leentjiesklip Caravan Park (site 3) which have implemented a managed retreat policy given high levels of coastal erosion.

5.4. Concluding remarks

The Saldanha Bay is a complex human-environmental system. Over the past four decades, the Saldanha Bay underwent numerous human-induced changes such as the construction of the iron ore jetty, the joining of Marcus island to the mainland by a causeway and increased coastal development. These human interventions altered the natural dynamics of the Bay, thus fuelled increased erosion along the Langebaan shoreline. The Langebaan case study provides an ideal illustration of the compounded nature of coastal risk within the Saldanha Bay as well as the role of extensive human processes in driving local coastal vulnerability and the long-term effects thereof.

Chapter 6

Findings

6.1. Introduction

Chapter 6 will present the findings derived from the fieldwork undertaken. The methods used were semi-structured interviews as well as a review of grey literature. Thematic analysis was used in which the data gathered was categorized into four overarching themes. Theme one examines stakeholders' interpretation of coastal risk, theme two explores the various responses to coastal risk along the Langebaan shoreline, theme three identifies the barriers to effective governance of coastal risk in the context of the Saldanha Bay Municipality (SBM) and theme four explores measures for strengthening governance in response to coastal risk along the Langebaan coast in relation to the Saldanha Bay Municipality (SBM).

6.2. Theme 1: Stakeholder interpretation of coastal risk

This section explores how various stakeholders interpret the notion of coastal risk.

In the case of this study, 24 stakeholders were asked to explain their understanding of coastal risk. Their responses were categorized and are presented below (see figure 10).

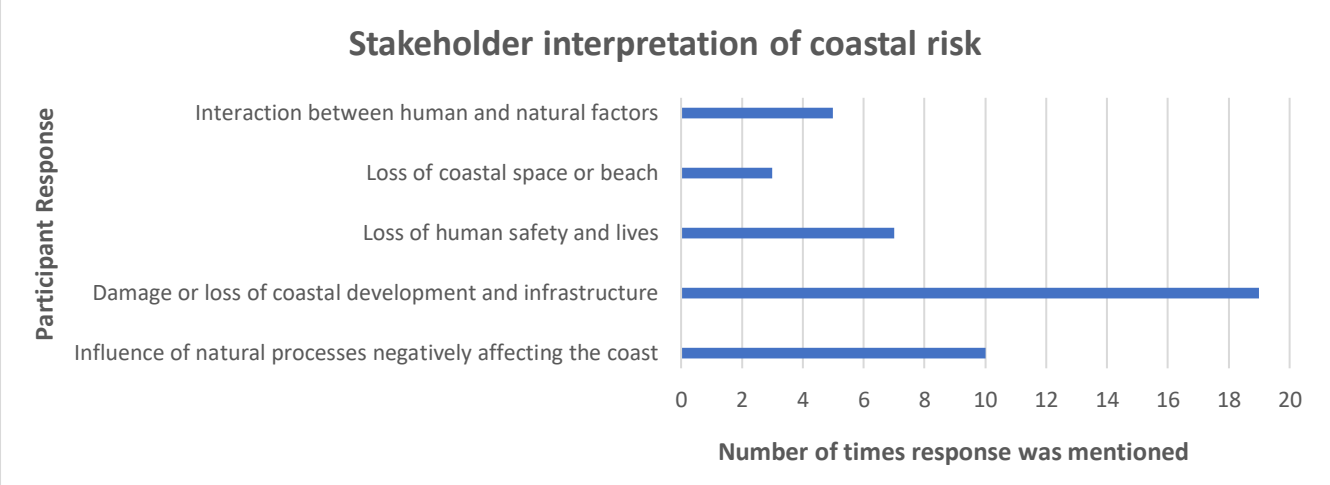

Figure 10: Stakeholder interpretation of coastal risk

The three dominant interpretations of coastal risk, as per the interview data collected, are unpacked below. As shown in figure 10, it is evident that most stakeholders mentioned damage to or loss of coastal development and infrastructure as a major sign of coastal risk. This response highlights that the short term physical loss of coastal infrastructure is deemed as serious and requires immediate attention. In

other words, the extent of damage or loss determines how stakeholders regard the seriousness of the problem. Stakeholders interpreted coastal risk as a physical short-term loss which is visually identified as oppose to it being gradual and long-term. The physical damage or loss of infrastructure underpins the dominance of hard engineering measures as a physical protection and short-term solution to a physical problem. Evidently, given the dominance of traditional engineering approaches to coastal risk, when asked whether erosion could be controlled, a coastal engineer argued, *"most definitely [it can be controlled], it comes down to valuation of coastal property and whether engineering solutions to erosion can justify expenses. [in other words], whether you can pay for it" (*EN2, August 2019).

As outlined by a provincial environmental official, *"in South Africa, property values near the coast are of high value but in other countries, property values are reduced [near the coast] due to risks [this is evident in many African countries]"*(PG2, March 2019). In relation to the case study area she added, *"the west coast is much harsher and has more development on sandy shores than rocky shores"*, thus having the *"biggest development risk*" (PG2, March 2019). Adding the interpretation of coastal risk as physical loss or damage, the municipal environmental manager amplified, *"we need to look past the aesthetics of things [beach views] and save people's lives and property"* (LG2, March 2019).

According to a long-time resident and fisherman, coastal risk is human-induced as "*people build on the high-water mark, [and] people want to be in the water"* (F1, May 2019). This speaks to the high demand for coastal property despite the high risk of being so close to the high-water mark. Another fisherman explained, *"[local residents are] living in a danger zone [as] you don't know what is going to happen, you can't see it but it's happening* [i.e. the increase risk]" (F2, May 2019) with reference to living along the coast.

The second most dominant interpretation of coastal risk is the influence of natural processes negatively affecting the coast. From this interpretation, it is clear that stakeholders acknowledge that external physical or natural processes such as storm events, wave action and erosion and the rise in sea level are at play and are impacting the coastal environment. A few participants, however, made direct reference to these natural processes being exacerbated by climate change. This interpretation also stresses the role of long-term physical coastal processes in fuelling coastal risk. In acknowledging the external natural processes associated with coastal risk, a former SBM Municipal Manager pointed out, *"it is difficult to police when people build on beach [as] you can't fight the sea"* (LG1, March 2019). As simply put by a former municipal coastal patrol officer, coastal risk is interpreted as "*the sea taking away the shore and washing away property*" (LG5, May 2019). Consequently, coastal risk is underpinned by uncertainty, which is difficult to plan and manage, as highlighted by a senior fire & disaster management official who said, *"how do you deal with something that you can't control"* (LG4, March 2019).

Similarly, some residents interpreted coastal risk as being *"loss of beaches"* and *"the disappearance of coastal areas"* (R1; R2, March 2019) which ties into loss of sense of recreational and natural value. One homeowner alluded to the fact that coastal risk is a *"worldwide problem [whereby] property and land mass are taken away from its natural environment"* (R4, July 2019). Another resident interpreted coastal risk in light of its uncertainty, as *"nobody plans for this"* (R3, March 2019).

The third dominant interpretation of coastal risk, as per the interviews, is the loss of human safety and lives. This interpretation, in relation to coastal risk is associated with climate-induced sea level rise and the potential damage or loss of coastal infrastructure and property and consequent impacts on human safety and lives. Here, once again, the narrative is underpinned by short term physical damage and impacts which affect human livelihoods, health and safety.

Based on the interviews conducted, it was evident that coastal risk was interpreted as a "*multifaceted concept which depends on the lens one looks at it"* (NG1, March 2019) as suggested by a national environmental official. According to a district fire & disaster management official, *"a risk is a risk*", however "*we need to categorise a risk based on priority risk on a scale of severity"* as this would allow for the *"risk to be better managed"* (DG2, March 2019). In light of this statement, the West Coast District Municipality, under whose jurisdiction the Saldanha Bay Municipality (SBM) forms part of, developed a risk register which is determined by the severity the risk is likely to have on the environment, infrastructure and human safety. The register categorises and determines the level of risk anticipated given its priority within the district. In terms of the disaster risk register, as seen in the attached appendix, coastal erosion and floods are ranked 11th and 14^{th,} respectively. Veld fires and drought are ranked as the top two priorities in the district. Adding to the interpretation and prioritization of coastal risk, a SBM environmental officer is of the view that, *"people don't regard coastal risk as an imminent threat [*so much so that] *people will deal with the situation when and if it happens"* (LG2, March 2019). In support of coastal risk being a priority given its context specific nature, a member of the Saldanha Bay Municipal Coastal Committee stressed, *"what makes Langebaan different, in terms of coastal risk is that it is caused specifically by human interventions, thus, risks are man-made"* (LG6, March 2019). This contributes to the interpretation that coastal risk is context specific and should be approached contextually.

A member of the Saldanha Bay Water Quality Trust Forum (SBWQTF) noted, *"coastal risk is a real risk, we [residents] first need to lose houses and lives and then something will happen*" (NGO2, March 2019). Considering the context specific nature of coastal risk, a member of the Langebaan Ratepayers & Residents Association found [historically], *"Langebaan as a town just happened ... initially a farmers' holiday town close to the beach [with] a lack of planning, lack of setback lines and no clear separation between the coast and property"* (NGO1, March 2019). This explains the extent of exposure

and level of risk experienced along the Langebaan shoreline given the limited forward planning at the time.

Coastal risk is regarded as an *"unexpected happening"* which "*nobody plans for"* (F2, March 2019) according to a local fisherman. Undoubtedly, it is interpreted as being context specific which requires context specific approaches in response thereto. A local restaurant manager interpreted risk (when the risk of disaster is imminent) as being *"what would cause me to pack up my business"* (B, March 2019).

6.3. Theme 2: Responses to coastal risk along the Langebaan shoreline

In elaborating upon the responses to coastal risk, this section will be divided into three sub-sections considering the actual local responses taken by the Saldanha Bay Municipality (SBM). The first response is hard engineering measures as in the case of the Langebaan North Beach rock revetments which were introduced in the late 1990's, followed by the construction of temporary (sand bags) groynes at North Street Bay which were developed in the early to mid-2000's. It was noted by several respondents interviewed that these hard engineering measures were the only appropriate options at the time considering the extent of erosion experienced after the 1997 storm. The second response to coastal risk has been managed retreat as seen at Leentjiesklip Caravan Park which was considered the best economically appropriate option. The third has been institutional responses in the form of policies and plans as well as institutional arrangements outlined by the SBM in response to coastal risk along the Langebaan shoreline.

Figure 11: Three study sites and physical approaches used in response to coastal risk (source: author's own)

The following section provides details of the findings associated with each of the responses to coastal risk undertaken by the SBM as identified above.

6.3.1. Approach 1 - Hard & Soft engineering measures

This approach, in particular also outlines peoples' interpretation of the local coastal environment prior to and after the 1997 storm, given the engineering measures introduced.

6.3.1.1. Site 1: Langebaan North Beach Rock Revetments – *"an emergency response"*

The 1997 storm which struck the Langebaan shoreline is well entrenched in the minds of older Langebaan residents given the extent of impact which it had on the shoreline. In understanding the significance of the 1997 storm, a Saldanha Bay Municipality (SBM) environmental officer emphasised *"the big storm caused this issue [of] coastal risk along Langebaan shore"* (LG2, March 2019). Residents who witnessed this storm event recalled that it washed away one house and damaged numerous properties in close proximity to the shoreline. The streets were flooded due to the poor storm water infrastructure.

According to a former resident and municipal coastal patrol officer, the extent of damage on one coastal property in particular was so severe that today *"the empty plot still stands"* (LG5, May 2019) of the house that was lost during the storm. A current resident outlined that on arrival in Langebaan in the late 1980's early 1990's, "*Langebaan north beach was a very long way from the property with loads of sand dunes"* (R2, March 2019), however, the storm removed all the natural barriers of sand dunes thus further exposing the shoreline and coastal properties to storm events. Another resident residing along Langebaan north beach mentioned that, *"approximately 100 m of beach was lost over 30 years - it was a very flat and wide beach."* (R2, March 2019). The image below illustrates the extent of damage which the 1997 storm had on coastal property along the Langebaan shoreline.

Figure 12: Extent of damage from the 1997 storm in Langebaan. Picture taken in 1997 (source: Cape Argus, 2013)

A former SBM Municipal manager described the Langebaan shoreline as previously being *"very wide* [so much so that] *one could walk from Langebaan to the town of Saldanha [further north] along the shoreline"* (LG1, March 2019). He further added [given the extent of coastal damage], *"the town was*

under threat, what would happen with the next storm, council realised that this [damages caused by the storm] is bigger than we imagined" (LG1, March 2019). With added pressure from the community and the potential risk of more houses being lost, "*a 1.4-kilometer revetment was introduced as an emergency response"* (LG1; LG2; LG3, March 2019). A SBM environmental officer outlined, *"the revetment was a reactive, emergency response [which was introduced] prior to the Record of Decision or, in today's terms, an environmental authorisation"* (LG1; LG2, March 2019). The majority of interviewees pointed out that the rock revetments were introduced within a year or two after the storm. As shown in the images below (Figures 13 and 14), the rock revetments are large granite boulders of rocks which were brought in from nearby and piled on top of each other along Langebaan north beach.

After the storm, a resident recounted that numerous local measures were used leading up to the installation of the rock revetments to try and save the beach such as *"putting blankets over dunes then sandbags then a small wall then the rock revetments came"* (R2, March 2019).

Figure 13: Rock revetments, the emergency response after the 1997 storm (source: author's own)

Figure 14: A house which lost its front section due to the 1997 storm (source: author's own)

6.3.1.1.1. Challenges associated with the Rock Revetments

After the installation of the rock revetments, many local residents acknowledged that even though the revetments were a *"quick fix emergency solution"* (PG3; LG1; LG2; LG6, March 2019; LG5, May 2019), it continues to be "*very effective in protecting houses and property [as] property still standing."*

After years of being a feature of the Langebaan shoreline, the rock revetments pose various challenges. Based on most interview responses, the top two challenges associated with the rock revetments have been identified as being safety concerns and limited access to the beach during high tide. In light of the reactive nature of the rock revetment, a national environmental official argued, "*the responses at Langebaan [the rock revetments and groynes] were implemented without any foresight to its appropriateness given [its] sustainability into the future [one of which is] the problem of who is responsible for its maintenance*" (NG1, March 2019).

Safety Risks

In terms of safety, a former municipal coastal patrol officer highlighted, "[during high tide] *water breaks in front of rocks [making it] very deep and dangerous"* (LG5, May 2019).

According to a coastal engineer the rock revetments were *"only effective in reducing flood risk and preventing erosion from undermining of adjacent property"* (EN2, August 2019). He continued by stating, "[the revetments] *provide a hard, dangerous barrier between land and the beach"* (EN2, August 2019). The rock revetments are *"not user friendly"* as "*it is a safety hazard to beach goers"*, proclaimed another coastal engineer (EN1, March 2019).

A resident ridiculed the revetments by saying, "[given poor access to the beach] *I'm going rock climbing now to get to the beach*"(R2, March 2019*)*. He further mentioned, *"I would like it [the beach] to be like in the past, walk out of the door and the beach is there"* (R2, March 2019).

Limited coastal public access during high tide

The impact on coastal access due to the rock revetments is another major challenge and cause of concern. This adds to the ongoing debate surrounding enhancing coastal public access as required by the Integrated Coastal Management Act (ICM Act) (chapter 2 subsection 7A) versus private property rights as required by the Constitution of South Africa (chapter 2 subsection 25).

According to a SBM environmental officer, *"private people [property owners along the Langebaan shoreline] fence off property which in some instances falls on coastal public property, during high tide, the sea is up to the revetments and the public is forced to walk close to private property as it is dangerous to walk over revetments"* (LG2, March 2019). She added that this is an ongoing problem, as *"this is not something that can be helped [i.e. the private-public access conflict]"* (LG2, March 2019). A SBM town planner noted in terms of public coastal access, *"the challenge is to find designated access points"* (LG3, March 2019).

Another challenge of coastal access includes the potential and perceived notion of theft given the narrow stretch of coastal space between the rock revetments and private property, further adding to the public-private coastal access debate.

Poor Monitoring and Maintenance

The lack of maintenance and monitoring of the revetments is touched upon by a provincial environmental official who stated, "[due to] *water undercutting, the revetments tend to collapse"* (PG3, March 2019). Similarly, during stormy weather *"water breaks onto the rocks [causing larger rocks to break] into smaller rocks and damage properties"* (LG5, May 2019) identified by a former municipal coastal patrol officer. In the same vein, a mayoral committee member for planning and infrastructure added, "*the revetments are in a state of movement given the soft sand beneath it and erodes from the bottom*" (LG6, March 2019) this further constrains its effectiveness during times of severe weather. This contributes to the safety risks associated with the groynes.

A resident and Saldanha Bay Water Quality Trust Forum member explained, *"the sagging of revetments [is experienced] at some points as rocks were dumped on soft sand, [which was] not a healthy solution but a reactive one"* (NGO2, March 2019).

A coastal engineer involved in the monitoring of these hard engineering measures argued, "[the rock revetments] *have done nothing to slow down erosion, hence the introduction of groynes and dredging for beach reclamation needed to arrest erosion [and] prevent sand from being introduced into the longshore transport and potentially accelerate erosion in front of the revetment"* (EN2, August 2019). The rock revetments will remain a feature of the Langebaan North beach as they continue to serve a central purpose of protecting coastal properties. As pointed out by a district environmental official, *"if you take it [the revetments] away, you need to put something in place of it"* (DG1, March 2019), given the fact that if the revetments are removed further aggressive erosion will take place and impact the already highly vulnerable shoreline.

Other challenges associated with the rock revetments highlighted by some respondents were that the revetments are not aesthetically pleasing as they change the sense of place of the beach and may reduce property values.

6.3.1.2. Site 2: North Street Bay's Temporary Groynes/Sandbags – *"A Pilot study"*

The Langebaan 'groynes' are now a local feature of the town although they were constructed as a temporary solution to the erosion problem. Although, the groynes are simply a stacking of sandbags, for the benefit of this project, this measure will be referred to as 'the groynes'. The groynes were constructed after the introduction of the rock revetment as part of the Langebaan Beach Restoration

Project. It became evident, however, that even though the revetments helped protect coastal properties along site 1 from the exposure of the waves, it has *"done nothing to slow down erosion"* as noted by a coastal engineer (EN1, March 2019; EN2, August 2019).

As mentioned by Clark et al. (2011), this prompted the then National Department of Environmental Affairs and Tourism (DEAT) in 2001 to provide the necessary funding to identify appropriate measures to arrest Langebaan's beach erosion and contracted a coastal engineering company namely Prestedge Retief Dresner Wijnberg Coastal Engineers (PRDW) to investigate possible solutions to the problem. Following the investigation by the engineering company a solution was identified in the form of building two groynes which necessitated an Environmental Impact Assessment (EIA) Record of Decision (ROD) or environmental authorisation. According to McClarty et al. (2006), as part of the EIA process, various long-term solutions were considered, which were presented at a workshop in 2001 attended by local as well as international coastal engineers. It was concluded that two groynes instead of three which was initially put forward would be constructed with material that was not harmful to the environment given the Bay's complex coastal processes. If any negative impacts were to surface as a result of the groynes, they could be easily removed. Following the approval of the EIA and associated ROD, which outlined that the maintenance of the groynes was assigned to the Saldanha Bay Municipality, an urgent beach reclamation programme was undertaken. This involved dredging large amounts of sand to replenish the beach as well as to fill the geotextile sand-filled containers (GSC), which were packed on top of each other to form a groyne.

Two groynes were constructed during the period 2005-2007. The first groynes was 250m in length and was completed in 2005 while the second one of 360m, was completed in 2007 (Clark et al., 2011). Figure 15 below illustrates the groynes from an aerial view and figure 16 shows the ground view.

Figure 15: Groynes from an aerial view (source: Google Earth)

Figure 16: The groynes at North Street Bay from ground view (source: author's own)

6.3.1.2.1. Challenges associated with the Temporary Groynes [sandbags]

Like the rock revetments, various challenges accompanied the installation of the groynes. Based on the interviews conducted, three major challenges have been identified, namely, the unclear responsibility for its maintenance, human vandalism and funding constraints for undertaking maintenance.

Unclear Responsibility to maintenance

In terms of responsibility for the maintenance of the groynes, an ongoing debate exist. On the one hand, The Environmental Impact Assessment's (EIA) Record of Decision (ROD) for the development of groynes in 2001 required that certain conditions be met. One of these conditions was that the maintenance of the groynes is the responsibility of the Saldanha Bay Municipality (SBM). On the other hand, the municipality argued that, considering the groynes are located below the high-water mark and within the Marine Protected Area (MPA) of the West Coast National Park, the responsibility for its maintenance lie with national government, namely the then Department of Environmental Affairs and Tourism (DEAT).

Environmental officials all confirmed that there was a lack of clarity regarding the responsibility for the maintenance of the groynes. However, they argued that while responsibility for the maintenance should lie with the municipal level, financial support was required from national government (NG1; NG3; PG1; PG2; PG3; DG1, March 2019). A provincial environmental official acknowledged that, "*province was the approval authority [ensuring that the monitoring was done] but both the municipality and province lacked management capacity [of the situation towards the maintenance of the groynes]"* (PG1, March 2019). Other government officials noted, *"the responses at Langebaan were implemented without any foresight to its appropriateness … in terms of funding and maintenance"* (NG1; PG3, March 2019). Certainly, the issue of responsibility for the maintenance of the groynes is *"an ongoing investigation on how to move forward"* (PG1; PG2, March 2019). From a municipal standpoint, it is understood that, *"the ROD [passed in December 2001] was made in the name of the municipality who*

took responsibility [for the groynes in order to adhere to the concerns of its ratepayers]. [However] the ROD was not clear [whether] to harden it [the groynes] or not [as phase 1 of the Langebaan Beach Restoration Project, which entailed the development of the groynes, was successful but continue to stagnant]. The future of the sandbags [or phase 2 of the Project] would entail introducing additional groynes" (LG1; LG2; LG3, March 2019). The municipality's hands are tied with regards to this given other major municipal priorities.

Local residents and NGO's mentioned, "[the groynes are] *very effective but need maintenance"* (R1; R2; NGO1; NGO2, March 2019). However, the question remains *"who is responsible for the groynes?"* (R1; R2, March 2019; F1, May 2019).

According to a coastal engineer *"the lack of maintenance is due to lack of ownership"* (EN1, March 2019). Another observed, "*no maintenance was done since its construction around 2004 and 2007".* He brings attention to the fact that *"the geotextile sandbag containers have a lifespan of approximately 15 years, and it [already] expired"* (EN2, August 2019). This shows a lack of coordination and integration between national, provincial and municipal government to address this coastal risk. This also speaks to the nature and challenge associated with unfunded mandates

Funding Constraints for maintenance

In light of the uncertainty surrounding responsibility for the maintenance of the groynes, limited funding further constrains the already highly disputed situation. Many government officials indicated, *"monitoring and maintenance of the groynes meant money [which] is an economic burden for the municipality"* (NG3, July 2019; PG1; PG2; PG3, March 2019). A district environmental manager stated, *"the SBM doesn't have the funding ... if left, it [groynes] will deteriorate further"* (DG1, March 2019). "*If not maintained, you will experience severe erosion [along the Langebaan shoreline]"* (LG1, March 2019). Municipal officials pointed out, *"the municipal budget needs to give preference to housing etc. [which are top priorities of the municipality] as the whole municipal budget will be lost to the groynes if the municipality takes over [its] maintenance ... which is on state property ... [and question] whether the municipality should fund an unfunded mandate?"* (LG2; LG3, March 2019).

Langebaan residents acknowledged, "[the groynes are in] *dire need of maintenance which comes at a major cost"* (NGO1; R1; R2, March 2019).

A coastal engineer mentioned, *"if the groynes are removed due to lack of maintenance and funding, rapid erosion will restart damage to property [along the Langebaan shoreline]"* (EN2, August 2019).

Human Vandalism

Saldanha Bay stakeholders identified vandalism of the groynes as a major problem, as shown by figure 16 (NG3, July 2019; PG3, March 2019; LG5, May 2019; LG6; R1; R2, March 2019; R4, July 2019; F1, May 2019). Moreover, many have identified, "*fishermen put the knives into the sandbags [while*

fishing resulting in the] sandbags washing up on the beach … [and in some instances] groynes disappearing under the sea" (LG5, May 2019; LG6, March 2019; R2, March 2019; F1, May 2019). The lack of education regarding the purpose of the groynes was a matter of concern and was needed to curb vandalism.

Another challenge relating to the groynes was that people found them aesthetically displeasing.

The future of the groynes

In terms of the future of the groynes, the environmental audit report, which was developed in consultation with key stakeholders and included comments from a public meeting held on 6 March 2012, identified the following actions required:

"the groynes should remain and that immediate steps must be taken by the SBM to repair the damage to the groynes and then to implement a maintenance programme to ensure ongoing efficacy and aesthetic value."

The report also make reference to the need for measures to prevent vandalism to be put in place.

Furthermore, in terms of financial maintenance responsibility, it was noted by the report that the SBM is to seek financial as well as technical support from local organizations to develop scientific studies and implement its findings, in order to ensure that informed decisions are made regarding further future options for Langebaan's beaches. (Commonground, 2012: 57).

The report also highlighted future local management options for Langebaan shoreline in light of the following considerations: promote proactive rather than reactive responses to coastal management through the initiation of a Municipal Coastal Management Programme (MCMP), ensure that coastal development enhance rather than restrict coastal access for the public and undertake context-specific studies on set-back lines and compliance to it in relation to appropriate as well as risk-averse coastal development proposals". (Commonground, 2012: 54).

In managing sea level rise, the report noted that its impact will be severely felt along the Langebaan shoreline given that the groynes have been suffering damage. "*If it is agreed that raising them [the groynes] would reduce their vulnerability to sea level rise, then this should be undertaken prior to any hardening of its surfaces"* (Commonground, 2012: 55). Despite suffering relative damage, the rock revetments have aided the protection of houses along Langebaan North Beach. The report argued, "*the process of data collection and background work into Phase 2 can begin with the integration of local government, industry and NGOs in the broader Saldanha Bay area",* considering the success of phase 1 (Commonground 2012: 57). Certainly, it can be deduced from the interviews that, apart from the need to drive environmental consciousness and sustainability within the Bay, the need for a solution (phase two of the Langebaan beach restoration project) to the Langebaan shoreline erosion issue progressed into further concrete forward thinking action needing to be taken, giving rise to the establishment of the

Saldanha Bay Intergovernmental Task Team (SBIGTT). The *"IGTT is looking for long- term solutions for the groynes"* (PG1; PG2; PG3; LG1; LG2, March 2019) (see section 6.3.2.2 for further responses). Through the efforts of the IGTT, a coastal engineer has been appointed and inspected the groynes. Based on the report by the coastal engineer *"the groynes are effective and work but [in the near future] phase 2 would entail smaller groynes [which] need maintenance, hardening and made permanent"* (LG1; LG2; LG3; LG6, March 2019; EN2, August 2019).

6.3.2. Approach 2 - Managed Retreat

6.3.2.1. Site 3: Leentjiesklip Caravan Park – "Let nature take its course"

Leentjiesklip Caravan Park (LCP), as shown in figure 11, is located further north of Langebaan north beach and is another site along the Langebaan shoreline experiencing coastal risk in the form of erosion. The caravan park is municipally owned and comprises of camping plots and holiday homes, many of which are located at the edge of the high-water mark. In illustrating the extent of coastal erosion along the LCP, Clark et al. (2012), point out that, as part of the Western Coast setback line development programme, (now referred to as management lines as per the Integrated Coastal Management Act (ICM Act) amendment), a coastal engineering firm concluded that the shoreline will retreat by approximately 12m in accordance with sea level rise projections of 1m over 100 years. Also, horizontal setback distances for erosion due to severe storms and tides is estimated at 15m to 56m at the caravan park (Clark et al., 2012). A homeowner at the caravan park stated, "*since 1999, approximately 12m of coastline has been lost to erosion*" [*email comm. R4, July 2019*].

Considering the vulnerability of this section of the Langebaan shoreline, an Environmental Management & Maintenance Plan (EMMP) was compiled by a consulting firm in response to various at-risk sites along the shoreline, with LCP being one of them. A number of options were identified by the EMMP in response to erosion along the caravan park shoreline which included soft and hard engineering measures. These measures included dune rehabilitation, constructing a submerged barrier and a managed retreat option. The managed retreat option was undertaken, which was noted by the Saldanha Bay Municipality (SBM) as the most effective both environmentally as well as economically, hence the reason behind its selection (Clark et al., 2012). As noted by the EMMP (2012) and State of the Bay Reports (2012 to 2016), one homeowner in particular (R4), is most at risk to coastal erosion with others being potentially affected in future. In light of the rate of erosion experienced, the one homeowner was notified to vacate his property as part of the municipality's ad hoc managed retreat policy. This was the first action taken by the SBM to implement managed retreat [*pers. comm. LG2, March 2019]*.

Figure 17: Leentjiesklip Caravan Park and holiday homes located close to the high-water mark (source: author's own)

Figure 18: Signs erected by LCP-homeowners to convey the seriousness of beach erosion along LCP (source: author's own)

6.3.2.1.1. Challenges facing Leentjiesklip Caravan Park (LCP)

As identified by some of the interviewees, lack of responsibility and support from the Saldanha Bay Municipality (SBM) is the most dominant challenge facing the caravan park. This challenge is directly underpinned by the SBM managed retreat policy at LCP which requires letting nature take its course and doing nothing to prevent increased rates of erosion along the LCP shoreline. One former national government official questioned the importance of saving the caravan park (NG3, July 2019). Provincial officials added, "*saving the caravan park would require more infrastructure which would mean more maintenance and more money"* (PG1; PG2, March 2019) which the municipality does not have, given that the homes which are at greatest risk are holiday homes. Another provincial official pointed out that by undertaking the managed retreat approach, it would allow the municipality to better maintain its existing infrastructure (PG3, March 2019).

Municipal authorities are in agreement that the caravan park property is leased by the residents from the municipality and whatever happens below the high-water mark (i.e. undercutting of the sand dune) is not the responsibility of the municipality (LG1; LG2; LG3; LG6, March 2019). It was further agreed by the SBM that the managed retreat approach is the best option available, as undertaking *"an Environmental Impact Assessment (EIA) [for the LCP area] is a lengthy and costly process"* which, in turn, would allow municipal funding to be used elsewhere (LG1; LG2; LG3; LG6, March 2019).

From an engineering perceptive, one coastal engineer noted, *"[managed retreat] offers an economically viable option*" and another stated that there would be high legal costs involved to prevent a managed retreat approach (EN1, March 2019; EN2, August 2019).
It should be noted, as identified by the SBM, that as part of the managed retreat policy taken specifically for the LCP, affected residents, particularly those located close to the high-water mark, should either vacate the area completely or move their homes several meters back therefrom given the risk of coastal erosion. It was also stressed by some local municipal officials given that the homes at LCP are holiday homes located on municipal land, the SBM will not be held liable if any damage results from the effects of coastal erosion, hence the motivation for its managed retreat policy. Similarly, nothing was mentioned by municipal officials interviewed regarding compensating homeowners affected by the managed retreat policy.

Homeowners at the caravan park, on the other hand, are in full opposition to the municipality's plan of managed retreat. It was identified by municipal officials that the managed retreat policy would entail moving the at-risk homeowner further back within the caravan park. It is agreed by both LCP holiday-homeowners interviewed that by continuing the managed retreat approach, the municipality "*put properties under threat by doing nothing"* (R3, March 2019; R4, July 2019). Furthermore, the homeowners emphasized, *"we are eager to engage with the municipality but they [the municipality] are unwilling to engage with us [the homeowners] about the situation … [as] … public input is useless"* (R3, March 2019; R4, July 2019). In an attempt to arrest erosion along LCP, some homeowners took matters into their own hands by bringing in truckloads of sand in order to protect and secure the dunes. Others put up signage, as shown by figure 18. As a possible solution to the erosion problem at LCP, homeowners' only plea is for the municipality to hand over authority to them to find appropriate mitigation measures as *"we [the homeowners] can pay [for the erosion mitigation measures]"* (R3, March 2019; R4, July 2019), but the municipality refuses to agree to this request. This explains the ongoing legal battle between LCP homeowners and the SBM.

6.3.3. Approach 3 - Institutional Responses to Coastal Risk

Several institutional responses to coastal risks have been introduced by the Saldanha Bay Municipality. Some of these are in response to policy and legislation required at the national level to address coastal risk. This section will be divided into two parts, the first part examines how various policies, plans and programmes which address coastal risk have been interpreted and implemented. The second part looks at the various institutional arrangements that have been put in place to respond to coastal risk.

The numerous policies and plans outlined below, which are required by legislation such as the Integrated Coastal Management Act (ICM Act) and National Environmental Management Act

(NEMA), are embraced by the SBM. However, as a result of unclear guidance to its implementation as well as financial constraints, the municipality fails to execute it effectively.

6.3.3.1. Implementation of legal provisions to address coastal risk

This section outlines the various legislative frameworks of relevance in response to coastal risk and reports on their implementation (See chapter 4 for a detailed description of South Africa's various legislative frameworks to governing coastal risk).

Legislative Framework	Government Sphere	Provision(s) relating & responding to coastal risk
Integrated Coastal Management Act No. 24 of 2008	National	-The establishment of coastal management lines to legally reinforce the protection of natural and socioeconomic interests associated with the coast from external risks such as coastal erosion and storm surges - Ensure effective planning for coastal vulnerability and risk to global and local change which includes climate change - the establishment of institutional mechanisms such as coastal committees and coastal management programmes in promoting collaborative and shared management responses and mandates to all sectors and spheres of government
Disaster Management Act No. 67 of 2002	National	-Promote a shift in thinking from the traditional disaster response to one of disaster risk reduction, prevention and mitigation -Introducing context specific disaster risk management planning and implementation to inform development-orientated approaches, plans, programmes and projects that seek to reduce disaster risk and finally implementing priorities concerned with disaster response, recovery and rehabilitation. This would include coastal risk
National Climate Change Adaptation Strategy of 2019 [DRAFT]	National	- Identifies the coastal zone as one of the key vulnerable socio-economic sectors and environments given increased land use change, coastal flooding and erosion. - The identification of these at-risk areas provides guidance on context appropriate responses to climate related risks such as flooding due to major storm events which is a major problem along South Africa's coasts. This would include at risk properties and infrastructure along the coast
Western Cape Coastal Management Line Project (WCCMLP) [NOT YET FINALIZED]	Provincial	-Determine where and how coastal development takes place in coastal municipalities in the Western Cape -Incorporate coastal management lines into planning legislation in order to ensure the development of coastal risk zones
West Coast District Municipality Disaster Risk Assessment 2012	West Coast District	-Shoreline erosion and floods have been identified as one of the numerous disaster hazards within the West Coast district

		-Risk reduction efforts should be targeted for sections of the coast that are vulnerable to storm surges and rising normal tide (as in the case of the Saldanha Bay)
West Coast District Municipality Climate Change Response Framework 2014	West Coast District	- Increased coastal flooding and inundation and increased erosion has been identified as climate-related risk by the framework for the district
West Coast District Municipality Coastal Management Programme	West Coast District	-Outline various measures and interventions required to effectively and sustainably manage the coastal areas of the West Coast District. -Of the external threat would include climate induced risks.
Saldanha Bay Municipality Second Generation Coastal Management Programme 2019 – 2024	Municipal	-As informed by the Saldanha Bay Integrated Development Plan, coastal management lines seek to protect coastal public property and private property and contribute to public safety - Coastal Management Lines must be incorporated into the Spatial Development Frameworks (SDFs) - Impacts of climate change need to be considered prior to approving applications for new development within the coastal zone - Erosion control measures must be implemented along sections of the beaches - Facilitates knowledge production and exchange and the promotion of knowledge sharing of coastal issues
Saldanha Bay Municipality Storm Water Master Plan [LIVING DOCUMENT]	Municipal	-The introduction of retention ponds reducing the amount of storm water outflow into the Bay which in turn reduced the extent of erosion along the Langebaan shoreline

Table 2: Relevant legislative frameworks in response to coastal risk

It is evident from the legal review that South Africa has an abundance of policies and laws to support the management of the environment. Several of these legal frameworks contain provisions to deal with threats and hazards. However, having a host of laws to deal with climate and human-induced risk can also be problematic because of the many different governance actors involved and responsible for different aspects of environmental management. It should be noted that throughout the interview process government officials were the main stakeholder group informed about the current state of governing coastal risk in the Saldanha Bay, hence the responses below reflect their interpretation of the application of the legal frameworks for coastal risk.

The majority of municipal officials indicated that governance continues to be a major problem for the Saldanha Bay Municipality (SBM). In outlining the value of local government and its institutions, a national governmental official mentioned, *"local government is on the ground [and is] the [most] responsive level of government"* (NG1: March 2019). Many government officials pointed out that local government was the level of government most challenged in the implementation of legislation (NG2;

PG1; PG2; PG3; DG1; DG2; LG2; LG6: March 2019). They referred to the lack of enforcement due to legislative language confusion as a major issue faced at the local government level, especially in a municipality like SBM. In the same vein, many interviewees highlighted, *"[governance issues at the municipal level is due to] lack of communication and collaboration with other spheres of government [as a result of] conflicting personal attitudes between government spheres and locals"* (NG2; PG1; PG2; PG3; R1; R2; R3; F2, March 2019). In using the example of the Integrated Coastal Management Act (ICM Act), all provincial officials explained, "*the ICM Act prescribes certain things [mandates] but it does not tell you how to implement it. The misinterpretation of legislation causes issues regarding mandate [as] the drafters of legislation had a certain interpretation but [local government] departments have a different interpretation [hence] people get confuse about different levels of government [involvement] and who is responsible for what [Langebaan shoreline erosion issue is an ideal example hereof]"* (PG1; PG2; PG3 March 2019). All government officials interviewed noted that roles are not being executed accordingly. This is evident in the SBM where a dedicated disaster risk manager and team is lacking, instead this function is incorporated into the municipal fire and rescue service, which is already under resourced and under financed, to further respond to disasters.
Similarly, due to this widening communication gap, *"a lack of clarification and information on legislation is being imparted from national to local government"* (PG3; LG3, March 2019).
Given the complexity and confusion surrounding legislation and the difficulty to implement it, several local government officials stated, "*the local and district level is burdened with a lot of responsibility [as a result of] a lack of information being imparted from national to local government [which often times] results in a blame game of who is responsible for what [as in the case of the Langebaan erosion problem]"* (DG1; DG2; LG2; LG3, March 2019).

Many interviewees, both government as well as non-governmental officials stressed, "*we have wonderful legislation but there are always loopholes and the enforcement [thereof] is lacking"* (PG2; DG1; LG2; NGO1; NGO2). Echoing the view of the majority of interviewees, a host of legislation exist, as shown by table 2, but in reality, it is difficult to implement, especially at the local government level. One official summed up the challenge of legislative enforcement as being, "*like a stop street, people will go over it but if you place a police officer there, people will stop, [in other words] you can have nice laws but if you don't have capacity to police it, it won't be effective"* (NG2, March 2019).

Speaking to the reactive nature of municipalities like the SBM, disaster risk officials pointed out, "*implementing risk [reduction measures] is a problem as something must first happen to respond to"* (DG2; LG4, March 2019). According to a few government officials, *"[poor] implementation of legislation is due to lack of capacity and resources [i.e. both human and financial restrictions]"* (PG1; DG1, March 2019). In the case of Langebaan's erosion problem, municipal officials explained, *"the municipality has no money to implement and address coastal risk [due to service delivery priority areas*

as] we have to address short term problems [and needs first]" (LG1; LG2; LG3; LG4; LG6, March 2019). Similarly, many officials acknowledged the lack of forward thinking at the municipal level. According to some municipal officials, "*the SBM doesn't have local policies [as the Integrated Development Plan is an example of a 5-year based planning] aligned with long-term planning [therefore] we [the SBM] lack a grand plan for long-term planning and continuity"* (LG2; LG3, March 2019). This is further outlined in the barriers to addressing coastal risk section.

At the same time, *"getting approval from authorities in response to an issue is a major challenge [adding to the implementation constrain at local governmental level"* (LG1, March 2019). District and municipal officials highlighted that many plans, policies and programmes in response to coastal risk such as the National Climate Change Adaptation Strategy of 2019, Western Cape Coastal Management Line Project, the West Coast District Municipality Coastal Management Programme and Saldanha Bay Municipality Storm Water Master Plan are yet to be finalised and adopted which further exacerbates issues surrounding its governance.

6.3.3.2. Local institutional arrangements in response to coastal risk

Apart from the municipal policies, plans and programmes which have been introduced, various local institutional arrangements and structures to addressing coastal risk in Langebaan and also other challenges facing the Saldanha Bay more broadly have also been established. These local institutional arrangements, which have been identified from the interviews and review of grey literature, include the Langebaan Beach Restoration Project overseeing committees and the Saldanha Bay Intergovernmental Task Team (SBIGTT), are presented below.

This section identifies the purpose and functions of the various local structures that have been established as part of the Langebaan beach restoration project and development of the groynes to address Langebaan's shoreline erosion problem at the time.

Since the 1997 freak storm various overseeing committees have been established in line with the Environmental Impact Assessment's (EIA) Record of Decision (ROD) for the construction of groynes as part of the Langebaan Beach Restoration Project. The Environmental Audit Report was a collaboration between the Saldanha Bay Municipality (SBM) and Common Ground, an environmental consulting group, which reviewed the success of the Langebaan Beach Restoration Project undertaken in the early to mid 2000's. The various overseeing committees as part of this project are outlined below.

6.3.3.2.1. Intergovernmental Liaison Committee (IGLC)

The IGLC, which has been disbanded, was established at the start of the construction phase of the Langebaan Beach Restoration Project (i.e. December 2003). The IGLC was represented by various

stakeholders from both the public and private sector. The committee sought to oversee the project, monitor application of funds, serve as a forum for matters arising from activities of the project and recommend payments (Commonground, 2014).

6.3.3.2.2. Environmental Monitoring Committee (EMC)

The EMC was set up in accordance with the Environmental Management Plan (during the construction phase) in December 2004. The function of the EMC was to monitor the groynes' construction process, oversee work of the environmental control officer, monitor the beach from an environmental point of view and report harmful activities to the SBM. EMC meetings were held on an adhoc basis during the construction phase and well attended by most representatives, which included SBM officials, Langebaan Beach Group, an environmental control officer and community representatives (Commonground, 2012:26). Apart from its role in the Beach Restoration Project, the EMC also raised many other broad environmental issues of concern within the Bay, such as noise, traffic, oil spills and hazardous material storage.

Public involvement in the beach restoration project was directed through the institutional arrangements mentioned above, who passed on the complains to the environmental control officer the contractor, the engineer and eventually to the SBM. The audit report indicated, "*stakeholder support and outlook was rather low* [and] *can be attributed to the partial success of the project, the current unmaintained state of the groynes and to the lack of information surrounding the project over the past three years*" (Commonground, 2012: 29).

It should be pointed out that these structures were established for the duration of the project and have been disbanded since. The findings suggest that, although these local structures formed part of the Langebaan Beach Restoration Project, it confirmed the need for collaborative input in response to local issues such as coastal erosion. These institutional arrangements engaged national government for financial support, technical experts on the scientific requirements for effectively implementing the project and in particular, the local community for their input to the local context, which, however was not as effective. Even though regular technical inspections are carried out on the groynes since constructed [pers. comm. EN2, August 2019], it brought to attention the reactive nature of engineering measures which, if not properly maintained, can fall into disrepair, thus requiring long-term integrative planning.

6.3.3.2.3. Saldanha Bay Intergovernmental Task Team (SBIGTT)

The SBIGTT was established in 2014, under the guidance of the Western Cape Provincial Department of Environmental Affairs & Development Planning (DEADP). The intention was that the SBIGTT

would function as a coherent, coordinated intergovernmental platform for addressing the deterioration of environmental quality given increased current and proposed future development in the Saldanha Bay area. Considering that Saldanha Bay is a key focal area for national, provincial, regional and local strategic development initiatives, a co-ordinated and coherent response is required from all spheres of government and public entities. This response requires the co-operation and support of civil society and business to ensure that the natural assets are not undermined and that desired environmental qualities are achieved *(PG2 & PG3, email correspondence, March 2019).* The IGTT is a collaborative platform to pull together all interested and affected stakeholders on issues affecting the Saldanha Bay. The IGTT is *"a vehicle to pull government together to address problems facing the coast*" Langebaan's coastal erosion problem is one of the issues that has been on the agenda since 2018 (NG1; PG1; PG2; PG3; DG1; LG1; LG2; LG3; LG6; NGO2, March 2019).

In distinguishing the IGTT from other stakeholder platforms within the Bay, a provincial environmental official stated, "*the real issues on the ground are able to be identified and dealt with quickly and efficiently"* and it *"assists in red- tape reduction"* as the *"public engagements identify issues from the public upfront and thereby streamline any public participation process … as well as keeping everyone informed"* (PG3, March 2019). As an intergovernmental task team, one of the issues on the agenda is the coastal erosion problem within the Bay with particular reference to the Langebaan shoreline. Other provincial environmental officials and IGTT members pointed out, "*the IGTT itself cannot action any activity, [instead] it ensures that relevant departments work together in a cooperative way and action their mandates accordingly"* (PG1; PG2; PG3, March 2019).

SBIGTT Stakeholder Forum

The IGTT hosts quarterly stakeholder forum meetings with numerous government and non-governmental stakeholders in attendance. Two meetings (23 August 2018 and 10 May 2019) are of particular relevance to this project as they focused on discussing the erosion problem
along the Langebaan shoreline as well as the current state and future of the groynes.
Based on the SBIGTT stakeholder forum minutes, two main points can be noted. The first acknowledges that attention must be given to Langebaan's erosion problem, because if not taken seriously, the problem will escalate. The second suggests that provincial government should partially facilitate the necessary steps to be taken in responding to this problem as well as the role of national government in financially assisting with a co-funding model in the development of additional smaller groynes and the maintenance thereof. In sum, the minutes reveal that greater coordination and collaboration among stakeholders is crucial in response to the Langebaan shoreline erosion issue as it is beyond the capabilities of the SBM. Clearly, collaboration amongst stakeholders in establishing viable long-term solutions is required.

The findings suggest that the SBIGTT highlights a practical example of addressing local issues in relation to broader factors as in the case of coastal erosion along the Langebaan shoreline. In doing so, the SBIGTT comprises of various public and private sector actors as well as local communities who played a vital role in the decision-making process. It acknowledges that long-term sustainable environmental and coastal management is underpinned by participation, knowledge sharing and collaboration. It is also clear from the findings that the SBIGTT demonstrates a shift from a problem-solution approach to one which involves collaborative engagement for collective and innovative thinking.

6.4. Theme 3: Barriers to effective governance of coastal risk in the Saldanha Bay Municipality

As deduced from the interviews conducted, the Saldanha Bay Municipality (SBM) is confronted by various barriers to addressing environmental issues particularly coastal management which includes coastal risk along the Langebaan shoreline. These barriers are identified below.

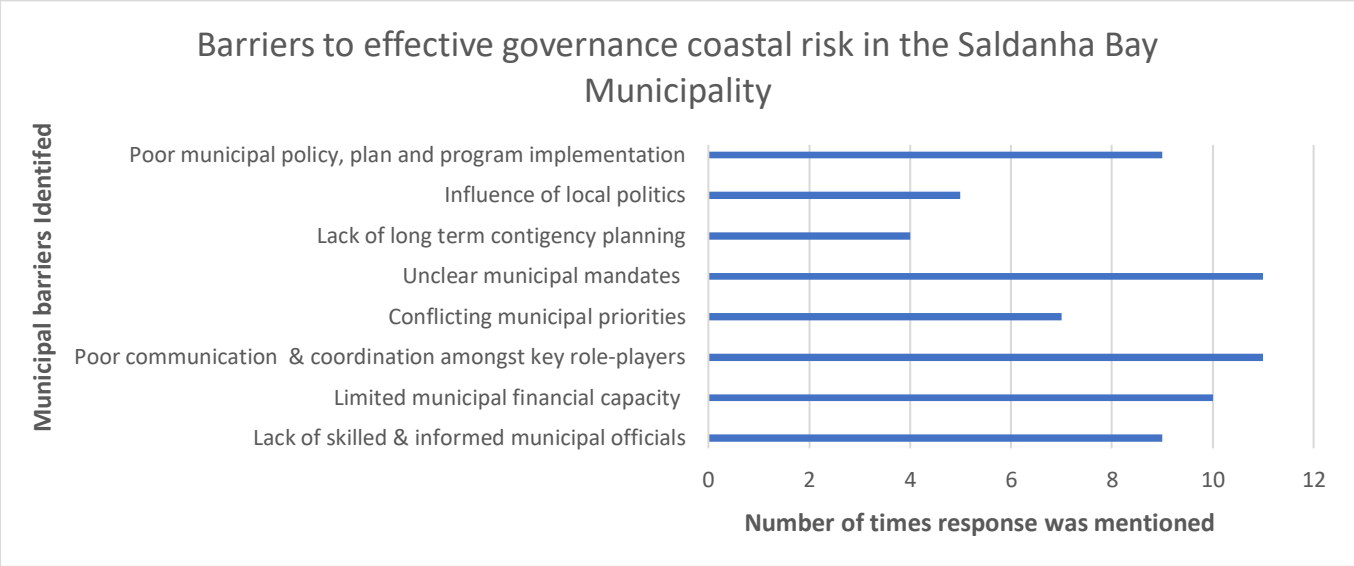

Figure 19: Barriers to addressing coastal risks in the Saldanha Bay Municipality

As illustrated in figure 19, the most prominent barriers to addressing coastal risk in the SBM are unclear municipal mandates and poor communication and coordination amongst key role players within and across different spheres of government.

According to national government officials, *"governance is always an issue"* (NG1, March 2019) given the challenge of *"building up from a once top-down approach … the issue lies at lack of communication and collaboration with other spheres of government" (NG1; NG2; PG1, March 2019).*

Provincial environmental officials noted, "[*in terms of unclear mandates particularly at the municipal level] the ICM Act prescribes certain things [mandates] but it does not tell you how to implement it [as*

a result of] misinterpretation of legislation cause issues regarding mandates [as] drafters of legislation had a certain interpretation but departments have a different interpretation" (PG1; PG2, March 2019). Consequently, "*people [i.e. provincial and municipal officials particularly] get confused about different levels of government and who is responsible for what"* adding to the communication gap (PG1; PG2; PG3; DG1; DG2, March 2019). A provincial environmental official pointed out that mandate confusion and communication gaps are interlinked at the municipal level. In highlighting the extent of unclear mandates, a district fire and disaster chief explained, *"the responsibilities of risk ownership are placed on non-risk owners [therefore lack of skilled officials result in poor responses to risks]"* (DG2, March 2019). In other words, officials are given responsibilities without any clear idea of what is expected out of them. This is exacerbated by poor communication between different stakeholders. Consequently, "*municipal government try and deal with issues on their own but cannot as most issues pop up at municipal level*; which is fuelled by the *"perception of mistrust between municipal and other levels of government",* thus constraining communication opportunities *(PG3, March 2019).*

Using the temporary groynes at Langebaan as example, local municipal officials are of the view that given a breakdown in communication regarding roles and responsibilities between local-district municipality, provincial and national government, fewer steps have been taken to provide maintenance thereof, which has resulted in a *"blame game*" (LG1; LG3; LG4; LG6, March 2019; LG5, May 2019). A mayoral committee member for planning and infrastructure outlined, "*the perception of the community is that local government is responsible for the environment [I.e. coastal risks]"* which is a challenge considering that solutions to environmental issues require collective buy in (LG6, March 2019). NGO groups argued that there is a lack of responsibility from the SBM and this is driven by a lack of political will, poor communication and overall bad management of the erosion issue (NGO1; NG02, March 2019).

In light of the widening communication gap mentioned, local residents stressed that local voices and views don't matter given the dominance of the intellectuals' views and inputs and that the municipality is not on the ground to experience the problem first-hand (R2; R3, March 2019; F1, May 2019; F2, March 2019). Many local residents, consequently, lose interest as they are not well informed and are hesitant to engage with local government. Therefore, poor communication between the different spheres of government amongst other stakeholders is a major contributing factor to poor governance within the SBM.

Another major barrier experienced by the SBM in addressing coastal risk is limited financial capacity. This was a common barrier identified by most interviewees, particularly by government officials. A national environmental official noted that municipalities are severely impacted by limited capacity, both human but more so financial capacity. He explained that, *"[given limited funding provisions] there are [limited to] no funds for municipalities [so much so that] local [government] can't fulfil environmental*

functions due to lack of expertise and resources to undertake projects" (NG1, March 2019). Furthermore, considering limited municipal funding provision provided for environmentally-related projects and monitoring programmes, coastal risk is not being given much attention (NG1; PG1; PG2; PG3; DG1; LG1; LG2; LG6, March 2019). This further adds to the poor implementation of measures to addressing risk and risk reduction which is evident in Langebaan considering past approaches adopted to its shoreline erosion problem. In adding to municipal financial constrains experienced by the SBM, a district environmental manager stated, *"EM is always last in line to receive funding … no real budget for environmental management [as there exist] budget cuts each year and reduced funding for environmental management*" (DG1, March 2019). West Coast district officials stressed that local and district municipalities are under resourced and burdened with lots of responsibility, therefore adding to their skewed roles and responsibilities and failure to achieve prescribed mandates as set out by policy and legislation.

Municipal officials highlighted that constrained financial support results in delays in responses, poor legislative enforcement, lack of skilled staff and no long-term contingency plans to address coastal risks and environmental problems more generally, hence the dominance of short term municipal planning approach (LG1; LG2; LG4; LG6, March 2019). This echoes the sentiments of a SBM municipal manager, *"coastal risk is bigger than municipal and province [level]"* (LG2, March 2019) and "*adaptation will cost money and thinking which the municipality does not have*" (LG6, March 2019), therefore national government ought to provide the financial backing to address this problem.

Other barriers facing the SBM in addressing coastal risk are the lack of consistent environmental monitoring programmes, the *"municipality is slow to react [to problems]"* (R1), increased private development along the beach as a result of historic zoning schemes which adds to the privatisation of the coast, hence "*the challenge of retrofitting Apartheid spatial planning [particularly along the coast]"* (LG2, March 2019).

6.5. Theme 4: Proposed measures to strengthen coastal risk governance in the context of the Saldanha Bay Municipality

Considering the barriers to addressing coastal risk within the Saldanha Bay Municipality (SBM), as identified by the interviewees, this section explores the proposed measures to strengthening coastal risk governance. It is clear from the interviews that strengthening coastal risk governance is underpinned by improving stakeholder communication and relationships.

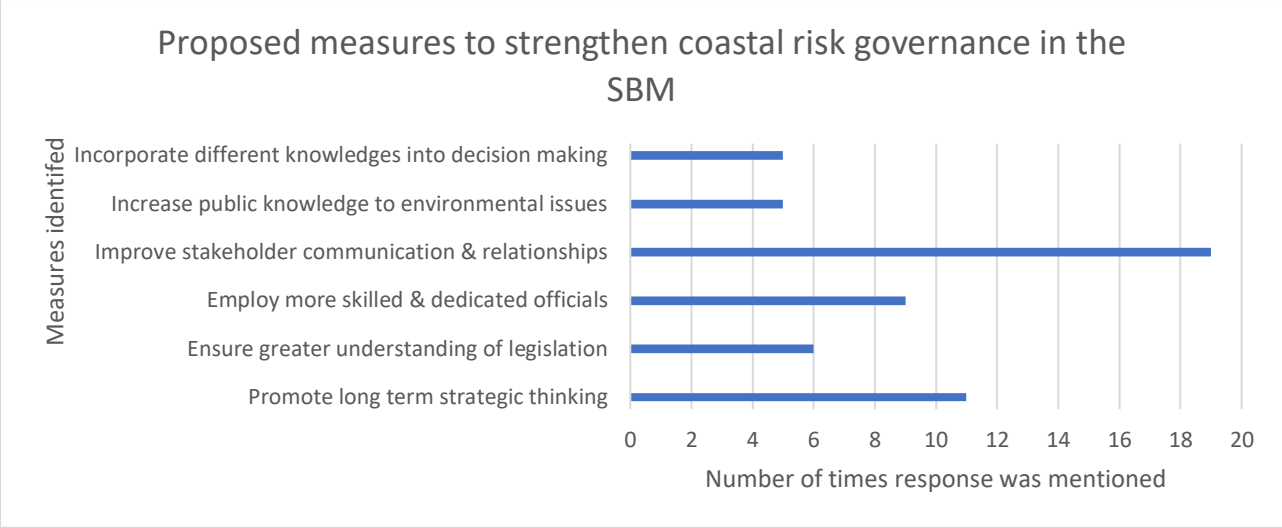

Figure 20: Proposed measures to strengthen coastal risk governance in the Saldanha Bay Municipality (SBM)

In terms of the interview responses, figure 20 clearly highlights that strengthening coastal risk governance in the SBM is underpinned by improving stakeholder communication and relationships. Environmental officials noted, *"pooling of knowledge"* is a vital part of building stakeholder communication and relationships as *"addressing coastal risk is a multi-faceted task and as such, will require a suite of short-term and long-term initiatives to address the balance that needs to be achieved"* (NG1; PG1; PG2; LG2, March 2019).

National environmental officials made mention that communication between different levels of government have been steadily improving through the creation of institutional structures and the mandatory public participation processes prescribed through legislation, such as the ICM Act (NG1; PG1; PG2; PG3, March 2019). Furthermore, "[there exist] *room for improvement especially at the local level for more effective operational implementation of plans and actions prescribed through provincial and national legislation*" (NG1; NG2, March 2019). Also, it was emphasised by government officials interviewed that locals are the ears and eyes of municipalities on ground as government can't be everywhere all the time, therefore building and strengthening partnerships are important (PG3; DG2, March 2019).

Indeed, the interviewees highlighted government officials' unanimity in their view that the SBIGTT pulls all role-players together in order to move in same direction (PG1; PG2; PG3; LG2; LG3, March 2019). The IGTT acts as the ideal platform to promote and foster collaborative stakeholder engagement in response to coastal risk in the Saldanha Bay. A mayoral committee member for planning and infrastructure argued that in order to build communication and foster stakeholder communication in response to coastal risk and any other environmental issue, the SBM must continue to encourage collaboration on improving participation of stakeholder in local stakeholder forums (LG6, March 2019).

Additionally, in sketching the ideal response to a disaster and the dire need to improve stakeholder communication, disaster officials stated, "*IDEALLY - in the event of storms and disasters [and if the municipality can't handle it on its own depending on level of incident severity] – the disaster office at the local municipality should report to District Municipal centre who then reports to provincial disaster centre who then report to national disaster management centre, however in reality, this set process is not actually followed … [therefore there is a] need for a more hands on approach with building relationships with other departments*" (DG2; LG4, March 2019). Similarly, "*in times of disasters, everyone needs to work together to stabilize the situation [by] starting off small and collectively and then building up towards long-term solutions [which are accepted by all]"* (LG4, March 2019). The idea of knowledge sharing through partnerships is required considering the interconnected nature of risk which would *"ideally incorporate expert as well as local community knowledge into planning and management as locals' experience risks first"* (LG4, March 2019; LG5, May 2019). This highlights the importance of engaging with local communities in the forward planning and decision-making process. *"The coastal erosion problem - is bigger than local [municipal government]"*, hence the need for improved communication channels outside of the requirements of the ICM Act is encouraged (LG6; NGO2, March 2019). The IGTT demonstrates government's (i.e. province and national) willingness to assist and build better communication within and outside of the SBM. Improved stakeholder communication and relationships are based on the premise that addressing coastal risk cannot be undertaken solely by one tier of government and or a particular sector, but through collaborative efforts (NG02, March 2019). At the same time, strengthening partnerships with the private sector is also essential (NG02, March 2019).

Residents posed the question, "*where does local resident's role lie … as we can't expect government to do everything … we [residents] need to play an interactive role"* (R1; R2; R3, March 2019; R4, July 2019; F1, May 2019). A local fisherman added, "*local government must listen to the people before acting [and they] need to work hand in hand [referring to local government and local communities working together]"* (F2, March 2019).

6.6. Concluding remarks

Coastal risk is a complex human-ecological issues issue that is synonymously associated with infrastructure loss and property damage. Langebaan shoreline erosion illustrates the compounded nature of coastal risk, which as a result required various responses (i.e. technical as well as governance). These responses include hard and soft engineering structures, managed retreat as well as institutional approaches in response to legislation and institutional arrangements. In light of this, the focus of this study, as informed by the 24 interviewees was to examine the various technical and governance

approaches to address coastal risk along the Langebaan shoreline, in order to propose alternative approaches that recognise the complexity, economic importance and vulnerability of this coastal zone. It was noted that the SBM is constrained in effectively carrying out its environmental mandate in response to coastal risk due to poor governance, which remains a major municipal barrier. Therefore, strengthening coastal (risk) governance is underpinned by improving and fostering stakeholder communication, which in turn is crucial for promoting long-term strategic and innovative thinking and action in response to coastal risk.

Chapter 7

Discussion

7.1. Introduction

The aim of this research project has been to examine the various technical and governance approaches to addressing coastal risk. Furthermore, it enables identifying appropriate context-specific approaches to improving Collaborative Coastal Risk Governance (CCRG), using the Langebaan shoreline as a case study. Semi-structured interviews were undertaken with 24 stakeholders including various government officials, coastal engineers, NGO's and local residents. Based on the findings of the semi-structured interviews, four central themes have been identified. These themes, which will be discussed in this chapter, are identified below:

- Theme one – Coastal risk as a contextually complex issue;
- Theme two – Exploring the traditional responses to coastal risk along the Langebaan shoreline;
- Theme three - Barriers to effective governance of coastal risk in the Saldanha Bay Municipality (SBM); and
- Theme four – Measures to strengthen coastal risk governance in the context of the Saldanha Bay Municipal area (SBM)

7.2. Coastal risk as a contextually complex issue

The coastal zone is a dynamic interface where human and environmental interactions meet in a non-linear manner. It is as a result of these dynamic interactions that scholars describe the coastal zone as a complex system (Azuz-Adeath & Arancibia, 2018; Newton & Weichselgartner, 2015; Dixbury & Dickinson, 2007). Certainly, Saldanha Bay, with particular reference to coastal erosion along the Langebaan shoreline, is viewed as a 'wicked environmental problem'. In fully comprehending the wickedness or complexity of Langebaan's coastal risk, the scholarship of Paul Cilliers and Jentoft & Chuenpagdee draws upon the characteristics of a complex system. Cilliers (2008) points out that complex behaviours develop as a result of the interactions between different components of the system, hence individual components cannot be looked at in isolation but through their relationships. Similarly, these are non-tameable problems which are symptoms of larger issues that operate at various scales, requiring context and long-term insight. Coastal erosion along the Langebaan's shoreline clearly supports the description of a 'wicked problem' (Jentoft & Chuenpagdee, 2009). It demonstrates the interaction and influence of human processes such as urban development and industrialisation with reference to port development, on coastal processes such as changing wave dynamics impacting on the local tidal systems, resulting in a loss of coastal dune system and land due to erosion along the shoreline.

These interactions, which spanned decades, starting with the development of the port in 1973 and the closing of one-third of the mouth of the Bay, presented new conditions which resulted in the reconfiguration of the Saldanha Bay system. This restructuring of the system resulted in an increased vulnerable shoreline to external risks. The history associated with the system cannot be divorced from the current state of the shoreline. The 1997 storm event, which was identified by the interviewees as a major local disaster given the strong winds, heavy rain and rough tidal conditions experienced, especially along Langebaan shoreline, illustrated the systems' response or feedback to the external influences within the Bay.

Theoretically, as supported by Cilliers (1998), the events leading up to the 1997 storm event, illustrated that as the Saldanha Bay system encountered different changes, new relations between various components, namely coastal processes were exacerbated by human interventions, causing increased vulnerability of the Langebaan shoreline. As shown by the findings, coastal risk along the Langebaan shoreline has been identified as a non-tameable problem or a problem that is not well-defined, therefore having a tendency to reappear. Thus, coastal risk as an attribute of a non-linear problem requires non-traditional solutions.

Another key element of a complex system are hierarchies and the interactions associated thereto. The events after the storm illustrated the system's adaptability to change through the presence of relationships of a hierarchical nature. As in the case of Langebaan, the hierarchies refer to the various institutional as well as non-institutional structures put in place to respond to its shoreline erosion problem. This, as illustrated and supported by the findings, involved cross-scale communication between hierarchies which, as argued by Cilliers (2008), is necessary in dealing with complex systems considering that hierarchies are transformable entities dependent on context. Therefore, as highlighted by the findings arising from the research, government institutions have a role to play given the need for greater coordination and alignment in response to complex environmental problems. Similarly, scholars have noted that interaction between numerous stakeholders, as demonstrated in response to Langebaan's shoreline erosion problem, acknowledges the complexity of the situation as a multi-scaled and collaborative process (McFadden, 2007; Bavinck et al., 2005). The Langebaan shoreline erosion case study brings to attention the importance of interdependencies within a system as a feature of stakeholder interaction in addressing a complex issue.

As a complex issue, coastal risk along the Langebaan shoreline is portrayed through various stakeholder interpretations. As suggested by the findings, coastal risk has been interpreted as an interaction between human and natural factors, the loss of coastal space or beach, loss of human safety and lives, external natural processes negatively affecting the coast and the most common interpretation being the damage and or loss of coastal development and infrastructure. This dominant interpretation of coastal risk

amongst respondents points to two intertwining aspects, the first stressing that, coastal risk is human rather than climate-induced and the issue that coastal risk can be "fixed" with technical solutions. This latter issue, which will be discussed later in this chapter gives prominence to the role and significance of hard engineering measures in response to coastal risk as risk is interpreted as a short term rather than long-term process involving gradual physical loss of shoreline. This is evident along the Langebaan shoreline. As ascertained from the findings, coastal risk along the Langebaan shoreline is interpreted as being human-induced. In expanding upon the idea of human-induced coastal risk, tourism and industrialisation in the form of port development will be drawn upon in support of this view.

This research has shown that tourism and port development are regarded as the foremost human-induced drivers of change within the Saldanha Bay. Coastal tourism is the fastest growing tourism industry in South Africa. At 3000km, the South African coastline is home to 40% of the population considering its commercial, recreational and industrial significance (Wigley 2011). Evidently, tourism and recreation is the central economic driver of the town of Langebaan due to its beautiful beaches, proximity to the West Coast National Park, opportunities for recreational activities and its ideal coastal urban setting. At the same time, Langebaan beach is synonymous with the town given its tourist popularity and high revenue associated thereto. The desire for coastal aesthetics is a driving force of tourism development (Phillips & Jones, 2006). The interviews revealed that the West Coast is known for its pristine sandy shores and coastal development, but at the same time, is known for its harsh coastal conditions.

In the same vein, tourism has a contributing impact to the vulnerable state of a coastal area. In support of this view, Lakshimi & Shaji (2015) explain that tourism and infrastructure development is a significant factor of economic growth for an area, however, due to commercialisation and radical changes to land use, which includes increased building density along a coastline, impacts on the natural functioning of ecosystems as well as the local culture of the area. In Langebaan, the value of coastal aesthetics resulted in numerous developments being built on the high-water mark. This research found that aesthetics triumphs safety within the context of coastal risk. Based on a study by Alexandris et al. (2015) which looks at the effects of beach erosion on tourism revenue, they argue that more beach equals more revenue, hence erosion threatens the value generated from loss of beaches. This further results in loss of coastal business competitiveness.

This research has also shown that in the case of Langebaan, in order to secure high coastal value along its shoreline, reactive hard and soft engineering measures were introduced to safeguard property and infrastructure. Consequently, considering the high concentration of development along the shoreline the associated risks, such as flooding and coastal erosion were exacerbated. As noted by the findings, numerous stakeholders pointed out that the introduction of engineering measures along the shoreline altered coastal processes in the Langebaan lagoon. Also, prevalent along the Langebaan shoreline are

multiple activities due to tourism resulting in conflict between users (Ballan & Ballan-Santini, 2001). Stakeholders interpreted the combination of development too close to the shore and projected sea level rise effects as being the loss of beaches and the overall loss of recreational and natural value.

Port expansion and industrialisation along the coastal zone is a contentious economic and environmental issue. As arising from this research, port development, is another major human-induced impact within the Saldanha Bay area with concomitant impacts for the Langebaan shoreline. Kudale (2010) argues that the construction of coastal structures and dredging activities as required for port development and its expansion, interfere with local coastal processes. Dredging, for instance, results in changes in local circulation patterns and increased sediment transportation especially in nearby estuaries leading to potential increases in local wave heights due to changes in wave refraction patterns and potential beach erosion due to the loss of the sand source (Mohanty et al., 2015; Sarma; 2015; Saz-Salazar et al., 2013; Kudale, 2010). Certainty, the Langebaan case study is evident of similar changes. Many stakeholders have pointed to the building of the causeway from the mainland to Marcus Island at the Saldanha Bay mouth as a result of the development of the port in the early 1970's as the main cause of the town's unstable shoreline. Sarma (2015) states that the problem of port expansion is the deepening of harbour channels in order to accommodate more vessels, which adds to economic opportunities in a given area.

In the case of Paradip Port in India illustrates the extent of erosion impacting the Odisha coast due to the obstruction of the longshore drift (Kudale, 2010). The development of the port during the early sixties involved the construction of coastal structures namely groynes, sea walls, two breakwaters and jetties which in turn altered the Odisha shoreline (Mohanty et al., 2015). Evidently, a major cyclone struck the Odisha coast resulting in erosion along the northern portions due to the intrusion of the longshore drift by the breakwater structures. The northern portion of the Odisha shoreline has to be regularly supplied with sand as a means of minimising the risk of further erosion. Certainty, the Paradip Port case study share similarities with the Saldanha Bay port development case study and its effect on Langebaan shoreline erosion.

Maharaj (2013), on the other hand, is of the view that port expansion is a major driver for job creation through the increase growth of manufacturing industries locally, and contributing to the overall national economic growth through improved port trade activity. The interviewees noted that port development is accepted by many in light of its economic contribution to the Bay. However, on the other hand, as another major human-induced process negatively impacting the Bay, many are in opposition thereto considering its gradual impact on the Langebaan shoreline, as already evident.

The coastal zone is sensitive to natural hazards as induced through sea level rise such as storm surges and flooding. South Africa is predominantly comprised of sandy shorelines which is highly susceptible

to climate-induced coastal risks such as sea level rise and associated impacts (Theron & Rossouw, 2008). Few interviewees made direct reference to natural processes, such as climate-induced sea level rise as fuelling coastal risk along the Langebaan shoreline. It was identified, however, that if these natural processes continue to be compounded by current human induced factors within the Bay, the shoreline will be severely impacted. Taking into account the uncertainty surrounding climate change and its effects on local coastal processes as highlighted by various scholars (Azuz-Adeath & Arancibia, 2018; Newton & Weichselgartner, 2013; Adger et al., 2005), it was interpreted by stakeholders that dealing with these external processes remains a challenge due to its uncontrollable and unpredictable nature. Findings from this research found, in line with Adger et al. (2005) that in the case of the 1997 Langebaan storm, coastal risks i.e. flooding and erosion, become disastrous due to lack of resilience of the socioecological system.

Furthermore, this research contributes to a study conducted by Theron & Roussouw (2008) who identified Saldanha Bay as one of the most vulnerable coastal areas in South Africa given predicted climate change impacts. The technical study took into account various biophysical coastal processes and parameters such as wave height and rates of erosion in determining the extent of its predicted exacerbation due to climate changes in each area identified. The study found that, given these parameters, the areas identified are at high risk of climate-induced changes and associated impacts. This research, by comparison, showed that the projected climate change impacts for the Saldanha Bay are underpinned by the various human-induced changes which further contributed to the Bay's vulnerable shoreline. In other words, in determining the vulnerability of a coastal area, the extent of human interventions ought to be understood.

At the same time, it provides a greater understanding of coastal risk from a more holistic perspective. This is particularly relevant along the South African coast whereby large sections of the coast have been modified by development for human activity. The Durban storm of 2007 clearly illustrated this, as its extent of damage was dependent on numerous biophysical as well as human factors such as a sandy shore, low coastal profile, the proximity of urban development to the high-water mark and coastal modification in the form of seawalls (Smith et al., 2007 in Wigley, 2011).

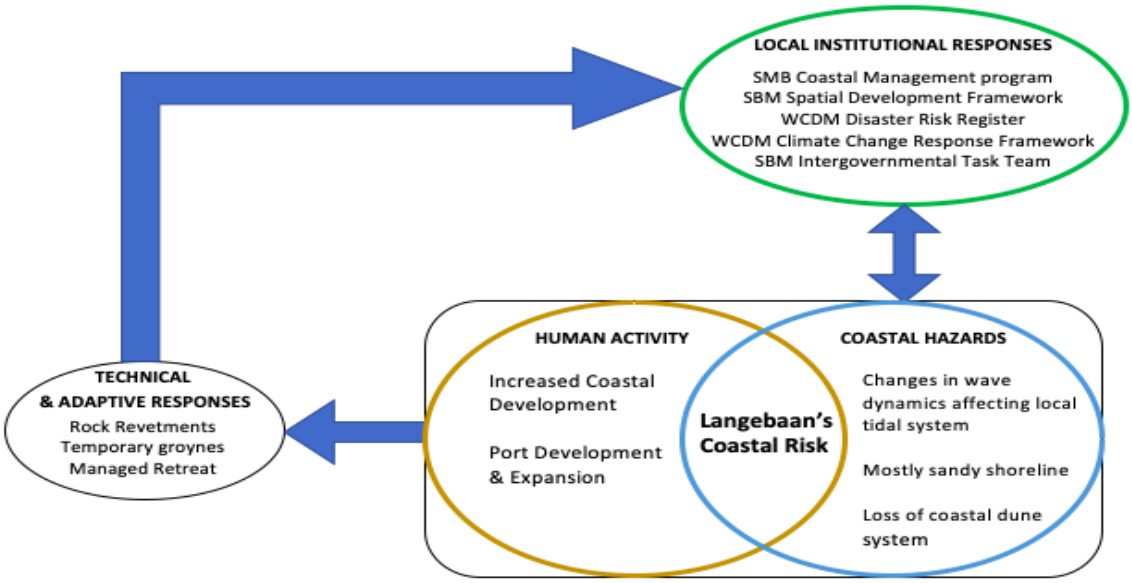

Figure 21: Contextually-complex nature of coastal risk along the Langebaan shoreline

As discussed above, figure 21 provides an illustrative representation of coastal risk as a contextually complex system. It points out that, as experienced along Langebaan's shoreline, coastal risk is a combination of human activities namely increased development driven by tourism and residential development as well as port development which involved the closure of one-third of the Saldanha Bay mouth. Coupled to these human activities, various biophysical changes emerged and affected the Langebaan shore; including changes in wave direction which affected the local tidal system, the loss of the coastal dune system as per these changes and increased erosion of the shoreline considering its sandy composition. In light of these coupled human-environmental factors, various responses were introduced to arrest coastal erosion. These involved traditional technical engineering responses such as rock revetments and temporary groynes as well as adaptive responses which involved managed retreat. Other local governance and institutional responses included the development of policies, plans and programmes such as the SBM coastal management programme and spatial development framework. Institutional arrangements like the Saldanha Bay IGTT were also created in response hereto.

Therefore, the findings from this research support the view of Jentoft & Chuenpagdee (2009) that environmental problems such as coastal risk are indeed wicked problems that are underpinned by human-environmental interactions and uncertainty which are non-tameable and a symptom of larger issues operating at various geographical scales. This view, as identified by the interviews, highlights that coastal risk is context specific and should be approached contextually.

7.3. Exploring the traditional responses to coastal risk along the Langebaan shoreline

Coastal risk associated with flooding and erosion is a worldwide problem facing regions of high coastal population density and development. One of the visible impacts associated with climate and human-induced coastal change is erosion. Coastal erosion is a process which refers to the permanent loss of sand from a beach depending on beach profile, levels of wave and wind activity, sediment composition and deposition and exposure at different temporal and spatial scales (Rangel-Buitrago et al., 2018; van Rijn, 2011). Hofman et al (2015) argues that adaptation is the necessary medium for managing the risks of climate induced coastal change given the impacts associated thereto which include property damage and loss of life. In doing so traditional engineering measures are commonly employed.

The traditional engineering approach to coastal damage is highly critiqued in the literature. The challenge of this approach is its one size fits all approach to non-tameable problems such as coastal risk. This approach is based on the assumption that these problems require a systematic method of engineering and scientific inquiry which can be applied and solved in a similar manner each time despite varying contexts (Jentoft & Chuenpagdee, 2009). Although technical fixes are perceived to be one of the best solutions to coastal risk, it is not ideal given its cost, maintenance, role in significantly altering the natural adaptive capacity of a coastline and potential contribution to further erosion (Rangel-Buitrago et al., 2018; Ballinger, 2015; Moser et al., 2012; Phillips & Jones, 2006). Scholars noted that even though technological or structural coastal adaptation options are useful in limiting the risk probability and potential effects thereof, it should not be regarded as the universal solution as its effectiveness is highly dependent on the economic, environmental, sociocultural and institutional contexts in which they are implemented and ought to be acknowledged (Harmon et al., 2015; Hofman et al., 2015; Glavovic et al., 2014; Smit et al., 2001; Klein et al., 2001; Klein et al., 1999). Similarly, traditional engineering approaches to coastal risk management are under strain considering the increased pressure of population concentration and development faced within the coastal zone.

At the same time, coastal risk management is based upon economic considerations and benefits of maintaining beach access and space (Cooper & McKenna, 2007). In maintaining the economic and commercial value of beaches from the impacts of coastal risks such as coastal erosion in particular, various hard and soft measures are utilized (Phillips & Jones, 2006). The use of these measures is regarded as a saving grace to the profitability of the coastal tourism industry. In line herewith, these responses to coastal risk are driven by short term local needs (Balinger, 2015). Moreover, until now, a high percentage of coastal risk management responses has been driven by the cost benefit analysis approach or financial considerations and reactive approach (Williams et al., 2018). As in the case of Langebaan, the need to secure its beaches, given its economic value, is the central reason for the introduction of various coastal engineering measures such as beach nourishment and groynes.

Figure 22: Actual approaches taken in response to coastal risk along the Langebaan shoreline (source: author's own)

Three overarching options for responding to actual or anticipated coastal change as well as the effects thereof are pointed out as protection, accommodation and managed retreat (Harmon et al., 2015; Klein et al., 2001). Scholars have further categorized these responses into five options namely armouring, moderating, restoring, abstention and adaptation (Rangel-Buitrago et al., 2018; Williams et al., 2018; Pope, 1997). Of relevance to the actual responses taken to address Langebaan's coastal risk, the first four options are discussed. Figure 22 above illustrates the various measures taken by the Saldanha Bay Municipality in responding to its eroding shoreline, with the addition of beach nourishment. The first three options are engineered-based.

Armouring is used where large amounts of human investment are at risk. These are applied in coastal areas experiencing rapid and chronic erosion. An example hereof will be the rock revetments along Langebaan's North Beach. The interviews pointed out that the main reason for its installation was due to the severe impact of the 1997 storm and the need to satisfy taxpayers by protecting properties along the shoreline. Stakeholders coined this approach as an "emergency reactive response". However, as outlined by the interviews, the rock revetments managed to protect the at-risk properties from major damage in the event of severe weather, but failed to arrest the ongoing erosion problem. Its failure to arrest erosion provided the rationale for the development of the temporary groynes at North Street Bay, which has been noted to be somewhat effective in maintaining beach width, pending further maintenance. Furthermore, the armouring approach accelerates erosion of sediment at the fore of the rock revetments resulting in steeper coastal profiles with deeper water and bigger wave energy smashing there against, thus questioning its safety risk.

Another challenge associated with the armouring option is limiting coastal access. As illustrative of Langebaan's North Beach, the interviews revealed that safety risk and limited access during high tide are of the major challenges being faced by the rock revetments. In terms of beach access, given the size of the rock revetments, at various sections of Langebaan North Beach, it limits public space, thus

infringed upon public access as well as private property. Some interviewees have stated that the rock revetments are ascetically unpleasant which alters the overall sense of place of the area.

The next approach is moderating or the slowdown of erosion rate. This approach is appropriate in areas where erosion is due to decreasing sediment supplies. An example of this is groynes, as evident at North Street Bay. The groynes, as identified by the interviewees, were introduced as a means of arresting the chronic erosion experienced along the shoreline considering the ineffectiveness of the rock revetments in doing so. Although the groynes react effectively in beach building and its construction is relatively easy and quick, however, in light of its effectiveness in mitigating the extent of erosion experienced, it comes with major maintenance responsibilities and cost. Engineering measures such as groynes have a finite lifespan given design specifications. As is the case of the groynes along the Langebaan shoreline, as a temporary measure, it has fallen into disrepair given that it reached its designed lifespan and further constrained by lack of maintenance. The interviewees pointed out to maintenance costs and human vandalism as a result thereof and being of the major current challenges facing the groynes along Langebaan shoreline. The steep costs associated to the maintenance of the groynes has been the reason for the lack of upkeep thereof by the Saldanha Bay Municipality, considering its unimportance in relation to other pressing issues. Furthermore, the idea of 'trapping sand' as a measure for beach growth can potentially impact neighbouring beaches as no sand deposition takes place downdrift (Williams et al., 2018; Pope, 1997). This is evident along the Langebaan shoreline whereby the area southwards of the groynes (i.e. closest to the entrance of the Langebaan Lagoon) is experiencing high levels of erosion, hence no beach exists in that area.

The third erosion control option is restoration. As a soft engineering measure beach nourishment is an example thereof. This measure seeks to work alongside rather than against natural coastal processes (Rangel-Buitrago et al., 2018; Williams et al., 2018). This is evident along the Langebaan shoreline with the Langebaan Beach Restoration Project that took place during the early to mid-2000's which lead to the installation of the groynes. The interviewees outlined that the project involved utilizing deposited offshore sand, which through dredging were redepositing onto Langebaan beach. The beach nourishment took place in the area between the two groynes or North Street Bay (see figure 22.). Up to today, a beach continues to exist here, thus benefiting Langebaan's highly prosperous tourism industry. Considering the high cost value of Langebaan beach, the interviews revealed that stakeholders were unwilling to allow the town's economic driver to be impacted upon, thus was to be protected and maintained with beach nourishment being one of the best options used. This is also the rationale to beach nourishment along the coasts of the United States (Phillips & Jones, 2006). However, despite its acclaimed sustainable nature in response to coastal erosion, beach nourishment requires periodic maintenance which is costly and constraining due to poor cooperative governance and the uncertainty

regarding who will pay for it. This is particularly evident in under resourced municipalities like the Saldanha Bay Municipality.

Another erosion control measure is abstention. This option entails having no active interventions and 'allowing nature to take its course'. The case of managed or planned retreat at Leentjiesklip Caravan Park is an example thereof. Managed retreat action allows the shoreline to move back and forth and or erode naturally given that all coastal development is relocated and or moved away from the shoreline (Rangel-Buitrago et al., 2018). Williams et al. (2018) points out that managed retreat is increasingly being viewed as a favourite option. However, as shown by the Caravan Park, tensions surrounding land eviction and relocation remains a major challenge associated thereto. This is also evident in Byron Shire, a coastal area, renowned for its beaches, located on the north coast of New South Wales, 200km from Brisbane, Australia.

In this case study, Niven & Bardsley (2013) points out that a lack of consistency in its managed retreat policy implementation lead to litigation issues by local residents against council. They further add that planned or managed retreat is a highly contentious policy choice which is often unpopular with local communities who are unwilling to relocate or evict their coastal properties due to loss of real estate value and increase market uncertainty. Therefore, concomitantly, as illustrative of LCP and Byron Shire beach property owners, issues surrounding land use, private property investment, public coastal value, equity and political acceptability limit the effectiveness of managed retreat (Niven & Bardslay, 2013).

In further critiquing engineering approaches in response to coastal risk, it is highlighted by scholars that the effectiveness of shoreline protection structures is not guaranteed and depends on context and climate change projections. Moreover, nothing that is built within a dynamic coastal environment will last forever (Williams et al., 2018; Moser et al., 2012). This is evident in the Langebaan case whereby certain parts of the rock revetments are sagging given its placement on soft sand as well as chunks of rock being broken down during major storm events. As stressed throughout the interviews, various stakeholders were of the view that the SBM lacked a long-term vision and insight with introducing the rock revetments and groynes. These engineering measures were based on short to medium term local planning strategies that focused on immediate socioeconomic benefits, which in turn paid little to no attention to the long-term coastal management consequences.

7.4. Barriers to effective governance of coastal risk in the Saldanha Bay Municipality

In South Africa, the municipal or local governmental sphere plays a vital role in driving and implementing local solutions to issues such as environment problems. Numerous scholars acknowledge the critical role of local government in environmental governance as it is the closest governmental sphere to communities and knowledgeable of local issues (Colenbrander & Bavinck, 2017; Peters &

Van Neiuwenhuyzen, 2014; Ziervogel & Parnell, 2014; Pasquini et al., 2013). It is true that this sphere of government interacts with local communities on a daily basis.

The overarching role of local government is to develop and foster an environment for efficient and effective service delivery as well as operationalise national and provincial initiatives in relation to various private and public sectors (Madumo, 2015). However, despite the transformation of governmental institutions after 1994, local government in particular, has a long way to go in becoming fully sustainable and functional considering the countless challenges or barriers being faced within this sphere (Peters & van Nieuwenhuyzen, 2014). In defining barriers as pressures that represses an individual or organisation, which in this case would be local government, from achieving collective goals, Biesbroek et al. (2009) portrays barriers as inherent of contextually complex problems.

In engaging the topic of municipal barriers to addressing coastal risk, it must be noted that much of the current research conducted of this nature is focused at the metropolitan level in South Africa with few concentrating on smaller municipalities like that of the Saldanha Bay Municipality (SBM). This research highlights that these smaller municipalities are institutionally challenged to addressing environmentally-related issues, in contrast to larger urban contexts such as the City of Cape Town. Evidently, it identified various municipal barriers facing the SBM in responding to coastal risk. The findings revealed that the major municipal barriers to addressing coastal risk are governance related. The barriers highlighted in the interviews include unclear municipal mandates and responsibilities, the poor implementation of municipal plans, policies and programmes, limited financial as well as human capacity and poor communication amongst key role-players (i.e. government and others). These barriers speak to the sentiments shared by various stakeholders who viewed governance as a constant issue of concern as it constantly evolves in relation to continuous changes in local conditions.
The ongoing challenges facing local government in South Africa are reconciling tensions between governance actors, stability and flexibility, short and long-term interests, collaboration and conflict and between centralised control and sharing of responsibility (Glavovic, 2016). Shackelton et al. (2015) states that tackling barriers enables improved governance responses to complex issues. The major municipal barriers, as identified by the findings will be addressed below.

7.4.1. Unclear and unfunded mandates at the municipal level

The implementation of responses can be constrained by legislation. As arising from the findings, this research has shown that unclear municipal mandates and responsibilities results in poor implementation of institutional responses at the local level. In this instance, institutions refer to policies, plans and programmes put forth by all government spheres including the SBM.

At the local level, laws and legislation can itself be a barrier given the challenge of translating policy rhetoric into practice (Glavovic, 2016; Shackelton et al., 2015; Peters & Nieuwenhyzen, 2014; Pasquini et al., 2013). Similarly, translating scientific jargon into public policy tends to confuse policy makers, thus complicating implementation (Glavovic, 2013). As in the case of Langebaan's eroding shoreline, municipal government officials echoed these sentiments and stressed that the Integrated Coastal Management Act (ICM Act) prescribes certain mandates to respond to climate induced change within the coastal zone but fails to provide guidance on how to implement these responses, resulting in misinterpretations thereof. In light to this, municipal officials in particular argued that misinterpretations associated with legislation implementation fuels the confusion surrounding roles and responsibilities at the local level. National and provincial government officials interviewed acknowledged that the implementation of legislation continues to be a major constraint, especially at the municipal level.

In a study conducted by Ziervogel & Parnell (2014), it was noted that the ambiguity surrounding responsibility lies in poor experimentation and interaction between different spheres of government and their roles. At the same time, Ziervogel et al. (2014) calls to attention the problem of red tape as one of the major drivers to municipalities' poor policy implementation. Evidently, government officials outlined that municipalities like the Saldanha Bay Municipality (SBM) attempt to deal with issues on their own, considering that most of these issues, like coastal risk arise at the local level. Municipalities, however fail to do so given that various municipal policies and programmes await approval from other spheres of government at national and provincial level, thus delaying the overall process. In light hereof, government officials interviewed further pointed to perceptions of mistrust between local government and other spheres of government as constraining communication, therefore adding to the confounded role and responsibilities particularly within local government. In further understanding this, Colenbrander et al., 2015 referred to the problem of unclear municipal responsibilities and implementation of its institutions as being compounded by conflicting institutional incentives and varying perspectives across governmental departments. If simply put, national legislation does not speak to the local context.

According to a study conducted by Roberts (2010), it was identified that capacity and 'institutional mismatch' exist which further obscures municipal department roles. The mismatch of roles is a major challenge for the SBM. In demonstrating this, a disaster risk official stated that municipal officials are given responsibilities, sometimes too many to manage, without any clear idea of what is expected and how these responsibilities are to be carried out. The challenge of unclear responsibilities is further expanded upon by Biesbroek et al. (2009) who are of the view that the lack of scientific knowledge and its incoherence in relation to the social, economic and institutional context in which policy implementation takes place, further adds to this.

Similarly, it was revealed from the interviews that the municipality lacked long-term planning as very few local mechanisms are put in place that enforces the implementation of climate induce change related responses to context-specific issues such as coastal risk. As clearly illustrative of the SBM, Biesbroek et al. (2009) bring to the fore that unclear division of who decides, who is responsible and who pays for the implementation of environmentally-related action contributes to the institutional void experienced within local government. Instead, as pointed out by the stakeholders interviewed, municipal matters remain unresolved due to undesignated responsibilities of departments and officials resulting in a 'blame game' which constraints issues in the event whereby drastic action is needed. This, as evident by Langebaan's eroding shoreline and the current challenges associated thereto, is further attributed to poor municipal administrative oversight and compliance, lack of engagement with other spheres of government as well as its inability to respond to the complexity of demands and expectations. Certainly, stakeholders drew attention to the lack of will and poor communication between key role-players within the municipality as being the driver of municipal irresponsibility to the effective management of Langebaan's erosion.

7.4.2. Limited financial and human capacity

Another major barrier currently facing local government in South Africa, with particular reference to the Saldanha Bay Municipality (SBM) is limited capacity. Municipalities do not have the means to address intricate environmentally-related issues such as coastal risk as it lacks the financial support and access to credible officials with the necessary practical skills relating thereto (Pasquini et al., 2013).

Capacity at the municipal level include human or staff, financial support and technical skills (Ziervogel et al., 2014; Pasquini et al., 2013). Local environmental officials interviewed stressed that within the West Coast District Municipality (WCDM) conservation & environmental management always receives the short end of the stick with regards to financial support given continuous budget cuts. With its constrained financial capacity, municipalities within the district such as SBM cannot effectively carry out their environmental functions (Ziervogel & Parnell, 2014). As a consequence of municipal financial constraints human and technical capacity is undermined. Human capacity, which in this regard include technical capacity, refers to knowledgeable municipal staff within a given department.

Limited human capacity is another major challenge faced by the SBM. This limitation hinders informed decision-making which would help in effectively coordinating responses (Ziervogel & Parnell, 2014). As outlined by stakeholders interviewed, limited human capacity within a municipal like the SBM results in delays in responses, poor legislative enforcement, lack of skilled staff and long-term contingency plans to addressing coastal risk and environmental problems more broadly. The interviews illustrated that municipal officials cited Langebaan's erosion problem as an example of this and emphasised that given poor management in the past, the municipality does not have the financial means

to appoint experts to scientifically address this issue moving forward. Moreover, the interviews pointed out to the fact that responding to Langebaan's erosion problem would be 'an economic burden' to the municipality.

In the same vein, municipal officials stressed that coastal risk is beyond the responsibility of local government considering its constrained human and financial capacity, hence external public and private assistance is required. In relation to this, Biesbroek et al. (2009) argues that constrained financial resources are the main barrier to effectively and sustainably responding to arising municipal issues. Other scholars account for municipal constraints as stemming from its failure to institute proper measures to ensure revenue collection and lack of institutional autonomy culminating in the lack of human capacity, failure towards regulatory compliance and overall realisation to mandatory goals (Madumo, 2015; Ziervogel et al., 2014; Pasquini et al., 2013; van Der Walt, 2002).

Polarized priorities are another factor contributing to poor policy implementation and a common challenged faced at local government level. This echoes the challenge of financial capacity. The interviews have shown that environmentally-related issues are under-prioritised in relation to socioeconomic issues and its urgency such as service delivery. As a result, the SBM tend to invest any available financial support to addressing service delivery issues. As pointed out by Pasquini et al. (2013), the undervaluation of the environment influences the extent of urgency of responses required thereto given that responses to environmental issues are normally gradual to long-term. However, the 1997 storm provided an example of the extent of damage which coupled human-environmental impacts can have on a system, thus the need for long-term insight and planning. This research has shown that the continued preference for reactive responses by the SBM and the lack of long-term planning in response to environmentally-related issues, constrains human and financial support which directly impact on its institutional functioning.

7.4.3. Lack of coordination with key role-players

Municipal barriers, as in the case of the Saldanha Bay Municipality (SBM), are underpinned by poor municipal communication with key role-players. Key role-players, as in this case, refer to all interested and affected parties such as governmental officials, NGOs, businesses and local communities, who are vital in addressing Langebaan's erosion problem. Communication continues to be a challenge due to competing interests and the need to maintain the status quo (Glavovic, 2016). The silo approach undermines institutional change and hampers improving communication (Ziervogel & Parnell, 2014). As illustrated by the findings from this research, the silo approach to tackling environmental issues remain prevalent in the SBM considering that communities consider local government to resolve these issues, therefore failing to acknowledge that its solutions require collective engagement. This speaks to previous studies conducted by Ziervogel & Parnell (2014) and Pasquini et al. (2013) on this topic, who

found that environmental departments across governmental scales are expected to address environmental issues, which, especially at the municipal level, cannot be done in isolation. This relay the importance of fostering vertical and horizontal coordination.

Scholars have pointed out that coordination is vital in governing the complex issues such as coastal risk considering the numerous actors involved as well as the interaction of various temporal and spatial scales (Ziervogel & Parnell, 2014; Ziervogel et al., 2014; Glavovic, 2013). Glavovic (2016) asserts that coordination within the institutional context help overcome entrenched practices and perceptions and help resolve conflict and collaboration tension. Similarly, as brought forward by the findings, limited consideration of stakeholder perceptions and needs in tackling Langebaan's erosion problem stems from the constrained vertical and horizontal coordination efforts encouraged by the Saldanha Bay Municipality.

As described by Winsvold et al. (2009) in Ziervogel et al. (2014) and supported by the findings gathered in this research, the Saldanha Bay Municipality finds itself with a knowledge and action problem whereby poor coordination prevents knowledge transfer and collective learning. Stakeholder collaboration improves decision-making effectiveness and coordination promote opportunities for engagement through dialogue, negotiation and cooperation (Glavovic, 2013). However, in reality, as in the case of the Saldanha Bay Municipality, the alignment between individuals and community interests in addressing Langebaan's eroding shoreline is skewed, thus impeding upon the decision-making capabilities of government institutions. Ziervogel & Parnell (2014) note that constrained coordination emanates from the perception that climate related issues are seen as environmental issues, therefore stakeholder relationships are built and fostered within instead of across departments and government spheres. That is particularly true in the case of coastal issues.

Coastal risk, in particular, is poorly understood given the dominance of traditional technocratic approaches in response thereto which limits holistic and integrated thinking and to some extent overlooks stakeholder engagement, therefore not addressing the problem in its entirety (Glavovic, 2013). Two points need to be noted in relation hereto, the first being the challenge of reframing issues such as coastal risk as a coupled human-environmental issue and the second being the need to integrate scientific and technical knowledge with the local social and institutional context in order to allow for collective engagement. Collective stakeholder input in response to complex issues pertaining to the environment remains a challenge. This is evident in the case of the groynes along Langebaan beach and the controversy surrounding them. The interviews revealed that a breakdown in communication regarded designated roles and responsibilities between local-district municipality, provincial and national government resulted in fewer steps been taken in providing maintenance thereof.

The same could be said for disaster management in response to coastal risk issues. Certainly, this, as historically evident in the case of the SBM, adds to the silo approach to responding to compounded issues such as coastal risk. As revealed by the interviews, SBM disaster management is an ideal example of how communication breakdown or lack of cooperation between governmental spheres as well as the lack financial and human capacity invested into this department, resulted in it being overburdened with responsibility, thus failing to deliver effective responses.

The sharing to risk amongst departments remains a challenge. This is shown in the case of SBM disaster management as climate change adaptation is not integrated into disaster planning. It is affirmed by this research which found that greater links and coordination is required between climate change adaptation and disaster risk reduction in tackling coastal erosion. Considering limited coordination between these knowledges at the local government level, as is the case in the SBM, appropriate action from government actors are hampered. As supported by a previous study conducted by Ziervogel et al. (2014) who pointed out that the challenge of responding to disaster risk, which in this case makes also reference to coastal risk along the Langebaan shoreline, is the hierarchical line of function which continues to be followed. In turn, this hierarchical process limits and constrains daily cross-departmental decision-making, thus particularly impacting municipalities and its governability to issues faced of climate change at the local level. This further speaks to the lack of coordination and interaction between all spheres of government.

At the same time, much of the information encompassing responding to environmental issues such as climate change is fragmented. This fragmentation is driven by poor communication between stakeholders which contributes to short-termism and a lack of long-term planning capabilities within municipalities (Biesbroek et al., 2009). Scholars outlined that politicians favour reactive short-term planning due to political and popularity gains resulting in an absence of clear policy directives in promoting integrative efforts between government spheres and its departments (Colebrander & Bavinck, 2017; Taylor et al., 2014; Ziervogel et al., 2014).

The ever-widening communication gap is due to the lack of integration between government and external role-players such as communities. In the case of Langebaan's shoreline erosion, residents stressed that the SBM fail to engage at the local level as community input is not considered equally valuable to that of professionals. This, as noted by the interviews, results in the loss of interest on the part of the local community, thus furthering the communication gap and potential partnerships which were to emerge. In truth, this is the current state of governance in the SBM which falls short at contingent planning in response to environmental issues such as coastal risk. At the same time, as identified by the findings, lack of long-term or forward planning, is due to the uncertainty surrounding coastal risk and who is responsible for future planning and adaptation planning in response to it. This is true considering that coastal risk is regarded as the mandate of environmental departments.

Certainly, it should be acknowledged that the challenges associated with addressing coastal risk within large urban contexts such as the City of Cape Town differ in extent to that of smaller municipalities such as the SBM. The findings which emerged from this research has found that the barriers in addressing coastal risk in municipalities like the SBM is further amplified in contrast to the City of Cape Town, given poor governance which is underpinned by geographical scale, financial and human capacity and institutional resilience. This, in turn, limits the extent of collaborative stakeholder engagement and contingency planning, which is the case of the SBM in response to coastal risk.

7.5. Measures towards strengthening coastal risk governance at the municipal level: The case of the Saldanha Bay Municipality

Coastal governance is an ongoing process as solutions to coastal issues requires constant engagement in order to develop robust and flexible responses thereto (Rangel-Buitrago et al., 2018; Clarke et al., 2013). In order to address the challenges facing local government in responding to coastal issues, its governance ought to be strengthened. The findings identified improving stakeholder communication and promoting long-term strategic thinking as central municipal measures required in order to improve coastal risk governance (CRG) in the Saldanha Bay Municipality (SBM). As arising from the findings, this research has found that strengthening CRG is underpinned by improving stakeholder relations and communication, encouraging knowledge sharing and dissemination for coastal risk response and adaptation and promoting collaborative & cooperative governance within the context of system complexity and uncertainty.

7.5.1. Improve stakeholder relations and communication: A necessary requirement for long-term strategic thinking and action at the local government level

Scholars have noted that conventional approaches to governance i.e. top-down traditional approach carried out solely by government, are not effective in solving complex issues such as coastal risk. This is due to its failure to recognise the complexity of these issues and the added diversity of stakeholders and their associated interests (Clarke et al., 2013; Jentoft & Chuenpagdee, 2009; Duxbury & Dickinson, 2007). Simultaneously, over the last two decades it has being increasingly recognised that wicked or complex issues cannot be viewed in isolation, hence solutions thereto will emerge through engagement with numerous stakeholders rather than through imposition. As underpinned by effective stakeholder communication, the governance perspective stresses that the dividing lines between public and private sectors i.e. government and non-governmental actors are blurred and not limited to one either sector (Bavinck et al., 2005). Indeed, this promotes integration as well as interdependence across government scale and knowledge discipline.

Considering the non-linearity and unpredictability of coastal risk, cross-sectoral collaboration is crucial in understanding its feedbacks and the required long-term responses thereto.
Stakeholders made reference to building and strengthening partnerships as collaborative efforts in responding to coastal risk. In line with this, Clarke et al. (2013) argue that collaboration, as a means of promoting and fostering stakeholder communication, improves the understanding between knowledge makers and decision-makers.

The case of Langebaan's shoreline erosion clearly highlights the need for improving stakeholder relations through greater communication. It also showcases the failure of the silo approach as being the hindrance of governments' problem-solving capacity. This is evidence of the Saldanha Bay Municipality's inability to respond to coastal risk in isolation given the influential compounding factors at play. Municipal officials went to the extent of emphasising that strategizing and responding to coastal risk is *beyond local government*. This speaks to the importance of trust building through collaboration in addressing the uncertainty tied to coastal risk.

The building of trust through establishing relationships improves efforts to resolve multiscale human-environmental issues by enhancing stakeholder capacity to respond proactively to uncertainty (Armitage et al., 2009). Considering the human-induced nature of coastal risk within the Saldanha Bay, the possibility thereof being coupled with climate induced changes such as sea level rise resulting in devastating effects, is imaginable, therefore requiring adaptive thinking in response thereto. Indeed, scholars have pointed out that adaptive thinking and stakeholder collaboration goes hand-in-hand in responding to uncertainty within a complex system (Cooper & Wheeler, 2015; Djalante et al, 2012; Armitage et al., 2009; Folke et al., 2005). Despite the numerous challenges facing local government, national and provincial government officials stated that cross-scale communication has been *steadily improving* through the creation of institutions which promote stakeholder communication as outlined through legislation such as the Integrated Coastal Management Act (ICM Act).

7.5.2. Encouraging knowledge sharing and dissemination for coastal risk response and adaptation

The interviews highlighted pooling of knowledge as being crucial in addressing coastal risk. This is true given the multifaceted nature of coastal risk which requires both short as well as long-term initiatives. In line with knowledge pooling, stakeholder participation involves as well as educates the public, increases transparency in decision-making and encompasses diverse viewpoints, fosters empowerment of local decision-making groups as well as establishes dialog which enables the development and implementation of locally-appropriate policies (Duxbury & Dickinson, 2007).

Government officials focused the attention to fostering collaborative knowledge through building partnerships as being essential. This would involve incorporating expert and local community knowledge into coastal planning and management. As pointed out by the interviews, establishing knowledge sharing partnerships demonstrates the importance of local community input and engagement in the decision-making process. In line with the idea of knowledge sharing, Djalante (2012) argues that the building of local community resilience is central to risk reduction and management through creating and supporting existing links between social networks particularly amongst 'non-traditional' stakeholders. Pasquini et al. (2013) and Popesu (2013) refer to this as *active involvement* in shifting problem-solving approaches towards the co-production of knowledge which places citizens at the fore within the decision-making and implementation process.

Scholars note that the inclusion of citizens into the decision-making arena redefines governance relationships on the basis of mutuality and reciprocity which, in turn strengthens locals' civic responsibilities (Glavovic, 2015; Sowman & Wynberg, 2014; Taylor et al., 2014; Popsecu, 2013). In echoing this, residents interviewed acknowledged their interactive role which ought to be played. Most certainty, this speaks to the need of involving local communities through knowledge dissemination which, in turn would promote collective responsibility in tackling local issues such as Langebaan's eroding shoreline. At the same time, the interviewees expressed that local government should recognise various stakeholders such as local communities, NGO's and businesses by incorporating their diverse knowledges into long-term collaborative planning in response to coastal risk.

Collaborative learning helps build long-term adaptive thinking knowledge, which is vital in understanding coastal dynamics and enabling appropriate planning and responses to external perturbations. This research has identified coastal risk governance, which is flexibly adaptive, as being centred upon building interactions and maintaining relationships by promoting long-term strategic thinking in response to coastal change at the municipal level.

7.5.3. Promoting collaborative & cooperative governance

The Saldanha Bay Intergovernmental Task Team (SBIGTT) act as a multi-sectoral and interdisciplinary institution for problem solving through promoting collaborative and cooperative governance. The SBIGTT is regarded as a highly influential institution to addressing various issues including coastal erosion, in the Saldanha Bay. As illustrated by the findings, the SBIGTT, which is comprised of local stakeholders, scientist and various government officials with differing roles, is premised on the idea that the integration of diverse knowledges is vital in establishing cross scale and sector linkages in order to address Langebaan's eroding shoreline as well as the overall sustainable management of the coastal zone. Jentoft & Chuenpadgee (2009) emphasises that a system is made up of interconnected relationships rather than its isolated parts. This speaks to the role of the SBIGTT in bringing together

various key role-players in collectively and holistically addressing issues being faced in the Bay. This research highlighted this by acknowledging the important role of the SBIGTT as a platform for promoting and enhancing collaborative stakeholder engagement and strategic thinking and action in response to various 'wicked issues', one of which being coastal risk.

Indeed, government officials outlined that the SBIGTT, in contrast to other stakeholder platforms, addresses local issues such as Langebaan's eroding shoreline, in its totality, by assisting in red-tape reduction as well as, through public engagements, issues are identified and publically streamlined to keep all informed. At the same time, they indicated that the SBIGTT *ensures that relevant departments work together in a cooperative way and action their mandates accordingly.* Furthermore, as pointed out by the interviews, the SBIGTT demonstrates provincial and national governments' willingness to assist and improve upon greater communication within and outside of the Saldanha Bay municipality.

The inclusion of different role-players into the decision-making process contributes to the continuous learning process, particularly at the local government level (Pasquini et al., 2013; Berman et al., 2012; McFadden, 2007). As a cooperative process, communication in response to complex issues such as coastal risk exposes stakeholders to new and diverse knowledges which promotes innovative and integrative responses. It also ensures that stakeholders are aware of changes and uncertainties taking place within the system (Lockwood et al., 2012; Djalante et al., 2011). As outlined by Lockwood et al. (2012) and illustrative of the SBIGTT, steps towards integration, decentralisation and localisation of knowledge includes increased cooperation amongst multi-sectoral, and multi-levelled partnerships. Government officials emphasised that in order for the SBM to improve upon its coastal governance, it should continue to encourage and foster collaborative engagement with its various stakeholders through local forums such as the SBIGTT.

The findings from this research has shown that the SBIGTT is notable in driving coastal risk governance as it highlights a shift from a problem and solution focus to one that brings into attention the creation and exploitation of collaborative opportunities, which to date has been effective in medium to long-term coastal planning and management. In this light, Ballinger (2015) outlines that long-term integration encompasses inter-sectoral, intergovernmental, spatial, referring to land and sea interactions and science-management-policy which highlights the importance of bridging the three. Certainty, this is apparent of the SBIGTT.

As per a collaborative process and given the contestation surrounding the maintenance of the groynes, moving forward, it was identified by the SBIGTT that a collaborative funding option involving all spheres of government is needed in securing as well as conserving the Langebaan shoreline. This potential funding alternative will allow for further studies to be conducted on sediment movement

within the Bay, which is the scientific evidence needed to undertake the necessary steps to further address Langebaan's erosion problem.

In sum, coastal risk governance (CRG) is centred upon the diverse interaction of numerous stakeholders, who collectively has an imperative role to play in working towards tackling municipal barriers, in order to strengthen municipal flexibility and adaptability in responding to the uncertainty associated to compounded human-environmental issues such as coastal risk.

Chapter 8

Conclusion

The coastal environment is an interface where human activities interacts with biophysical processes in a non-linear manner. It is within this environment that the impacts of climate-induced changes are severely felt (Newton & Weichselgartner, 2013; Goshen, 2011; Brooks et al., 2006). Coastal risk, which encompasses impacts associated with sea level risk such as increased flooding and erosion, is further exacerbated by coastal sprawl, overdevelopment and infrastructure such as urban roadways (Brown et al., 2011). Conventional approaches in response to coastal risk constitutes hard engineering measures such as dikes, levees, seawalls, floodwalls, revetments and groynes as well as soft engineering measures which include beach nourishment, restoration of wetlands and the creation of sand dunes. However, the literature has shown that these reactive engineering solutions are costly, temporary, require maintenance and add to the problem instead (Rangel-Buitrago et al., 2018; Sano et al., 2011; van Rijn, 2011). Increasingly, scholars are calling for greater integrated, multi-disciplinary and collaborative responses to coastal risk and its governance (Glavovic, 2015; Glavovic, 2013).

Coastal risk governance (CRG) is centred upon ongoing sharing of knowledge and ideas between experts, local communities and decision-makers. This collaboration promotes holistic innovation and adaptive thinking in response to climate and human-induced coastal issues and promote responses that are likely to be locally appropriate (Sowman & Wynberg, 2014; Glavovic, 2013). In light of the limited recognition given to coastal risk as a complex human-environmental issue and the sectoral and technical responses to tackling these problems, this research raises the question of how CRG can be strengthened in response to climate and human-induced coastal change at the local level?

The aim of this study was to examine the various technical responses and governance approaches employed by the Saldanha Bay Municipality (SBM) to address coastal risk along the Langebaan shoreline, in order to propose alternative approaches that recognise the complexity, economic importance and vulnerability of this coastal zone.

The research objectives included identifying and exploring stakeholder interpretations of coastal risk along the Langebaan shoreline; exploring the various responses (i.e. engineering and institutional) to addressing coastal risk along this shoreline; identifying the barriers to effective governance of coastal risk within the SBM and suggesting measures to strengthen CRG in the context of the Saldanha Bay Municipal area.

8.1. Key Findings

Coastal erosion in the Saldanha Bay area is an example of a localised complex human-environmental issue that involves complex interactions between industrial, recreational and biophysical processes, and more recently climate change. The major storm of 1997 highlighted the culmination of these interactions and impacts and resulted in disastrous effects on the Langebaan shoreline in the form of coastal erosion.

Various reactive steps have been taken in response to Langebaan's eroding shoreline since the 1997 storm. These mainly included hard and soft engineering measures such as construction of rock revetments and groynes as well as beach nourishment. Managed retreat has also been implemented as a long-term solution. However, considering the immediate and reactive nature of these responses, the engineering measures in particular are criticised as limiting beach access, thus fuelling public-private conflict. These hard engineering measures are also considered to be a safety hazard and are falling into disrepair and require regular maintenance which is costly. The financial and capacity constraints experienced at the municipal level added to stagnation of innovative and alternate solutions to the problem.

Local municipalities like the Saldanha Bay Municipality (SBM) are crippled by the lack of human and financial capacity in responding to environmental problems such as coastal erosion. The SBM is confronted by poor communication with its key stakeholders resulting in unclear municipal mandates, which further results in poor implementation of its municipal plans, policies and programmes in response to coastal risk. This has been made known by stakeholders' belief that coastal risk is beyond a municipality's mandate considering the extent of financial support and cross-scale stakeholder collaboration required.

South Africa is known for having a plethora of policies and laws at different levels of government. However, in reality, institutional arrangements and capacity to execute these provisions as legislatively required seems to be lacking. This is particularly evident at the local government level as in the case of the SBM.

Strengthening coastal risk governance (CRG) in under-resourced municipalities like the SBM requires improving communication and coordination amongst all relevant stakeholders including different spheres of government, private sector actors and civil society. Building effective stakeholder relations, and strengthening collaboration will encourage and promote long-term strategic thinking and appropriate local action.

The Saldanha Bay Intergovernmental Task Team (SBIGTT) established in 2014, provides an ideal platform for strengthening coastal risk governance through integrated and innovative responses to

complex coastal problems. as it fosters holistic and collaborative engagement in relation to local issues facing the Bay, with coastal erosion being one such issue. The potential of this platform is evident considering the various stakeholders, including state and non-state actors as well as local communities, involved in problem-solving and decision-making processes. The SBIGTT highlights a shift from a problem-and-solution focus to one which exploits collaborative opportunities in attaining sustainable coastal planning and management.

8.2. Recommendations

Based on the findings of this study, a number of recommendations are made.

- Climate and human-induced coastal change should not be overlooked at the municipal level, instead local municipalities need to be capacitated to be able to respond in a proactive and integrative manner by incorporating scientific and technical expertise in conjunction with local and institutional knowledge
- Enhanced financial support should be provided to local government, especially in under-resourced smaller municipalities like the Saldanha Bay Municipality in order to enable fulfilment of environmentally-related mandates.
- Institutional guidance and support from national government is critically needed at the local government level with respect to legislation coherence, interpretation and implementation in relation to coastal risk associated with inappropriate coastal development and climate change impacts.
- A need exists for greater co-ordination across sector departments both at municipal level and vertically across all relevant spheres of government.
- The establishment of partnerships between local municipalities and research institutions is vital in order to undertake context-specific and research relevant projects, which assist in addressing and reducing coastal risk.
- Greater investment in promoting improved public communication, as well as involvement in and information-sharing on local environmental issues are required as such involvement would promote collaborative knowledge creation and problem-solving.
- The private sector plays a vital role in coastal and environmental management and ought to be incorporated into the planning and decision-making process at the municipal level

8.3. Future research

The findings of this study point to future research that could assist in the governance of coastal risk at the local level, and in the Saldanha Bay Municipality (SBM) area in particular. One area of research would be to explore the legal parameters for addressing private and public coastal access in the Langebaan case under a scenario of increasing shoreline erosion, considering that coastal access remains a major contentious issue. This research would be of great value in assisting the SBM to legally respond to this issue.

During the interviews, many stakeholders pointed out to the disconnect between legislative requirements and implementation at the local government level and the need for this disjuncture to be addressed. Therefore, another potential research avenue could be to critically examine the effectiveness of the Integrated Coastal Management Act (ICM Act) in realising municipal coastal management strategies and identify barriers and enabling factors.

A further area of research concerns local stakeholder perceptions of coastal risk and its influence on municipal coastal planning in response to climate and human-induced coastal risk. This research theme speaks to unpacking the underlining factors at play in influencing coastal planning and decision-making.

Finally, another research area would be to identify how barriers to addressing climate and environmental risk interact across government scales. This research would ideally explore how addressing national level barriers may or may not resolve municipal level barriers in responding to environmental and coastal issues, including climate change impacts.

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Appendices

Participant Informed Voluntary Consent Form

DEPARTMENT OF ENVIRONMENTAL AND GEOGRAPHICAL SCIENCE

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Project Title: Governing Coastal Risk: The Case of Langebaan's Disappearing Shoreline

Invitation to participate, and benefits: You are invited to participate in a research study conducted with *various state and non-state actors.* The study aim is to develop *a greater understanding of how coastal risk along Langebaan's shoreline is governed within the context of climate and human-change.* I believe that your experience would be a valuable source of information, and hope that by participating you may gain useful knowledge.

Procedures: During this study, you will be asked to *answer questions relating to the governance of coastal risk in Langebaan. This interview is semi-structured which mean that questions have already been prepared based on specific topics of relevance to the study. Complete honesty is required.*

Recording: We will voice record this interview as part of the study. If you object to this, please indicate below.

Risks: There are no potentially harmful risks related to your participation in this study.

Disclaimer/Withdrawal: Your participation is completely voluntary; you may refuse to participate, and you may withdraw at any time without having to state a reason and without any prejudice or penalty against you. Should you choose to withdraw, the researcher commits not to use any of the information you have provided without your signed consent. Note that the researcher may also withdraw you from the study at any time.

Confidentiality: All information collected in this study will be kept private in that you will not be identified by name or by affiliation to an institution. Confidentiality and anonymity will be maintained as pseudonyms will be used, if requested.

What signing this form means:

By signing this consent form, you agree to participate in this research study. The aim, procedures to be used, as well as the potential risks and benefits of your participation have been explained verbally to you in detail, using this form. Refusal to participate in or withdrawal from this study at any time will have no effect on you in any way. You are free to contact me, ask questions or request further information at any time during the interview.

I agree to participate in this research (tick one box) ☐ Yes ☐ No _____ (Initials)

I agree to be audio-recorded

_____	_____	_____
Name of Participant	Signature of Participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

Interview Questions

Questions for current Langebaan Businesses & Property Owners

1. How would you define coastal risk?
2. If any, what changes have you notice any changes to the Langebaan shoreline?
3. What do you think are the factors (natural or human) contributing to these changes along the Langebaan shoreline?
4. How are these factors impacting on the Langebaan shoreline?
5. What impact did the storms of 1997 and 2002 have on the Langebaan shoreline?

*[For Interviewees – North Street Bay (sandbags/groynes)]

1. When were the sandbags/groynes installed?
2. How effective has the groynes been?
3. What are the problems associated to the groynes?
4. How can these obstacles be remedies?

*[For interviewees - North beach (rock revetments)]

1. When were the rock revetments installed?
2. Why were they installed?
3. How effective are the rock revetments?
4. What are the current problems associated with the rock revetments?
5. How can these problems be remedied?

*[For interviewees - Leentjiesklip (caravan park)]

1. In your view at what rate is erosion taking place along Leentjiesklip caravan park?
2. What are the residents' responses to managed retreat as the result of the erosion?
3. What are the current major tensions which exists at this site?
4. How can these tensions be remedied?

6. How have your business OR your property been impacted by the eroding shoreline?
7. How have you responded to the impact on your business OR property?
8. Apart from hard engineering measures, how else has the SBM responded to Langebaan's eroding shoreline?
9. Is enough opportunity for the public to give input towards addressing Langebaan's eroding shoreline problem?
10. What do you think should the role of national, provincial and government be in dealing with environmental problems such as Langebaan's eroding shoreline?
11. What should local government do to improve greater public input into environmental problems such as Langebaan's eroding shoreline?
12. In your view, how effective are integrated task teams, such as the Saldanha Bay Intergovernmental Task Team (SBIGTT), as a collaborative communication tool across governmental scales in addressing coastal issues such increased flooding and erosion?
13. If any, how can it be improved?

Questions for non-Langebaan Residents

1. How would you define coastal risk?
2. If any, what changes have you notice to the Langebaan shoreline?
3. What do you think are the factors (natural or human) contributing to changes along the Langebaan shoreline?
4. How are these factors impacting on the Langebaan shoreline?
5. What impact did the storms of 1997 and 2002 have on the Langebaan shoreline?
6. How has the Saldanha Bay municipality (SBM) responded to the risk (erosion & flooding) along Langebaan shoreline (from South Beach to Leentjiesklip Caravan park)?
7. How effective do you think the response by the SBM to reducing erosion and flooding and overall destruction of coastal infrastructure is?
8. What do you think are the problems associated to the groynes?
9. What do you think are the problems associated to the rock revetments at north beach?
10. What do you think are the problems associated to the manage retreat of local residents at Leentjiesklip caravan park?
11. How do you think these problems can be addressed?
12. Apart from hard engineering measures, how else has the SBM responded to Langebaan's eroding shoreline?
13. Is enough opportunity for the public to give input towards addressing Langebaan's eroding shoreline problem?
14. In your view, how effective are integrated task teams, such as the Saldanha Bay integrated task team, as a local collaborative communication tool across governmental scales in addressing coastal issues such increased flooding and erosion?
15. What do you think should the role of national, provincial and government be in dealing with environmental problems such as Langebaan's eroding shoreline?
16. What should local government do to improve greater public input into environmental problems such as Langebaan's eroding shoreline?

Questions for Saldanha Bay Municipal Officials:

1. How would you define coastal risk?
2. What should the role of provincial government be in tackling the problem of climate induced coastal risks?
3. What should the role of local municipal authorities be in tackling the problem of climate induced coastal risks?
4. What are the current challenges facing coastal management in the Saldanha Bay?
5. What do you think are the main factors (natural or human) contributing to coastal risk along the Langebaan shoreline from North beach up to Leentjiesklip?
6. How are these factors impacting the shoreline from North beach up to Leentjiesklip?
7. What have the municipality (OR SPECIFIC DEPARTMENT) done to minimize the impact of coastal risk along the Langebaan shoreline?
8. What policies or processes have been put in place to address the impacts of coastal risk along the Langebaan shoreline?
9. How effective have these measures been?
10. Given the contestation surrounding the groynes at and data suggesting its effectiveness, what are the municipality's plans for the groynes?
11. With regards to enhancing beach access, how is private and public property rights being addressed and fostered (i.e. along North Beach)?
12. How will the municipality be dealing with the contestation around managed retreat at Leentjiesklip caravan park given current and future coastal erosion?
13. The Saldanha Bay Municipality (SMB) have taken different approaches to responding to coastal risk, how were these approaches informed?
14. To what extent was the public involved?
15. What were the time horizons which informed these approaches?
16. What are the tradeoffs to addressing coastal risk, if any i.e. economic vs environmental & short vs long-term tradeoffs?
17. What do you think are the 2 major barriers to addressing coastal risk from North beach to Leentjiesklip?
18. How can it be improved?
19. What is the role of the Saldanha Bay Intergovernmental Task Team (SBIGTT) in improving communication and collaboration between stakeholders in responding to coastal risk such as erosion along the Langebaan shoreline?
20. How effective has the SBIGTT been thus far?

Questions for Western Cape Provincial (Environmental) Officials

1. How would you define coastal risk?
2. What are the biggest challenges/barriers facing coastal management in the Western Cape
3. What do you think are the main factors (natural or human) contributing to coastal risk along the Western Cape coast?
4. How are these factors impacting the Western Cape shoreline?
5. What policies or processes has the provincial government institutionalized to minimize these risks and associated impacts along the Western Cape coast
6. How effective have these measures been?
7. How can these measures be improved?
8. What do you think are the tradeoffs to addressing coastal risk, if any i.e. economic vs environmental and short vs long-term tradeoffs?
9. What should the role of provincial government be in tackling the problem of climate induced coastal risks along the Western Cape coast
10. What should the role of local municipal authorities be in tackling the problem of climate induced coastal risks
11. How effective are the levels of communication between national, provincial and municipal government with regards to tackling climate induced risks facing the Western Cape coast?
12. To what extent are different provincial departments collaborating in addressing coastal risks along the Western Cape coast (e.g. environmental dept. / town planning etc.) Please elaborate.
13. How can the levels of communication and collaboration be improved?

Questions for Coastal Engineers

1. How would you define coastal risk?
2. What do you think are the factors (natural or human) contributing to coastal risk along the Langebaan shoreline (i.e. flooding and erosion)?
3. How are these factors impacting on the Langebaan shoreline?
4. What impact did the 1997 and 2002 storm have on the Langebaan shoreline?
5. Which stakeholders took responsibility for addressing its impacts?
6. How effective were the responses to the storms?
7. In your opinion, can erosion truly be controlled?
8. From an engineering perspective, what is your view on coastal management lines and its effectiveness in responding to climate induced risks such as sea level rise and coastal erosion
9. In your estimate, what is the rate of erosion along Langebaan shoreline (per year?)
10. Leading up to the installation of rock revetments and groynes, to what extent was collaborative engagement with various stakeholders from the Langebaan community and Saldanha Bay municipality taking place
11. Who were all involved in this stakeholder collaboration leading up to the approval of installation of rock retrenchments and groynes?
12. As put forth in the State of the Bay Report, data has shown that the groynes have been somewhat effective in reclaiming Langebaan's main beach. What is your view thereon?
13. What are the current challenges associated to the groynes
14. What will the future of the groynes be? Will it ever be made a permanent feature of the Langebaan shoreline.

15. How effective are the rock revetments along North Beach in minimizing the impact of coastal erosion and flooding?
16. If any, what are the current challenges associated with the rock revetments
17. In you view, how important is monitoring in ensuring the long-term sustainability and effectiveness of coastal defenses (such as rock retrenchment and groynes)
18. From an engineering perspective, what is your take on managed retreat in response to coastal risk (using the example of Leentjiesklip Caravan Park)
19. If any, what do you think are the trade-offs to addressing coastal risk given the Langebaan case study
20. What should the role of national and provincial government be in addressing coastal risks?
21. What should the role of local municipalities such as the SBM be in addressing coastal risks?
22. In your view, how effective are integrated task teams, such as the Saldanha Bay Intergovernmental Task Team (SBIGTT), as a collaborative communication tool across governmental scales in addressing coastal issues such increased flooding and erosion?

Questions for the Saldanha Bay Municipality Disaster Risk Official

1. How would you define coastal risk in terms of disaster risk?
2. What do you think are the main factors (natural or human) contributing to coastal risk along the Langebaan shoreline from north beach up to Leentjiesklip?
3. How are these factors impacting the shoreline from South beach up to Leentjiesklip?
4. With the 1997 and 2002 storm events which took place in the Bay, what was the extent of damage along the Langebaan shoreline
5. Which stakeholders took responsibility to addressing its impacts
6. What was the approach which was used, did it include working with impacted residents?
7. How is the Integrated Coastal Management Act (ICMA) integrating long-term planning into Disaster Risk Management (DRM) in the wake of climate induced risks at a municipal level
8. What are the current challenges facing coastal management in SBM from a DR perspective
9. What is the relationship between the SBM DR and other stakeholders in terms of response planning prior and post major storm events
10. how effective are its measures?
11. how can these measures be improved?

Questions for the Saldanha Bay Intergovernmental Task Team (SBIGTT)

1. When was the SBIGTT formed?
2. What was the rationale to the formation of the SBIGTT?
3. What do you think is the role of the SBIGTT in addressing and minimizing the risks impacting the Langebaan coastline, one of which being coastal/shoreline erosion?
4. Thus far, what has the SBIGTT's approach(es) been to address the problem of coastal erosion along the Langebaan shoreline?
5. As a collaborative tool between various stakeholders across governmental spheres, how optimistic are you of the success and effectiveness of the SBIGTT in addressing the challenges faced within the Saldanha Bay, more specifically along the Langebaan shoreline?

Questions for Leentjiesklip Caravan Park Home-Owners

1. How would you define coastal risk?
2. If any, what changes have you notice any changes to the Langebaan shoreline?
3. What do you think are the factors (natural or human) contributing to these changes along the Langebaan shoreline?
4. How are these factors impacting on the Langebaan shoreline?
5. What impact did the storms of 1997 and 2002 have on the Langebaan shoreline?
6. Please provide a very short background to Leentjiesklip Caravan park
7. In your view at what rate is erosion taking place along Leentjiesklip caravan park?
8. What are the tensions associated to residents' responses to managed retreat as the result of the erosion at Leentjiesklip Caravan park?
9. How can these tensions be remedied?
10. How have your property been impacted by the eroding shoreline?
11. How have you responded to the impact on your property?
12. What is the relationship between coastal erosion and stormwater outflow at Leentjiesklip specifically?
13. How has the municipality addressed this problem?
14. Is enough opportunity for the public to give input towards addressing Langebaan's eroding shoreline problem?
15. What do you think should the role of national, provincial government be in dealing with environmental problems such as Langebaan's eroding shoreline?
16. What should local government (i.e. Saldanha Bay Municipality) do to improve greater public input into environmental problems such as Langebaan's eroding shoreline?
17. In your view, how effective are integrated task teams, such as the Saldanha Bay Intergovernmental Task Team (SBIGTT), as a collaborative communication tool across governmental scales in addressing coastal issues such increased flooding and erosion?
18. If any, how can it be improved?

Saldanha Bay Intergovernmental Task Team (SBIGTT) Stakeholder Meeting Minutes

The SBIGTT hosts quarterly stakeholder forum meetings with numerous government and non-governmental stakeholders in attendance. The 23 August 2018 and 10 May 2019 meetings are of particular relevance to this project as erosion along the Langebaan shoreline as well as the current state and future of the groynes were discussed.

Thursday, 23 August 2018

At this meeting, the matter of Langebaan's coastal erosion and maintenance problem was tabled and discussed. A specialist workshop was convened on the 24 August 2018 and a coastal engineer was involved to assess the specific set of erosion issues and advised on the way forward with regards to Langebaan groynes and general coastal erosion concerns (Saldanha Bay Intergovernmental Task Team Stakeholder Forum Meeting, 2018).

Furthermore, in terms of a sediment study for the Bay, an environmental official in attendance pointed out, "*there are issues linked to the mandate in relation to offshore sediment monitoring, Western Cape DEA&DP Coastal Management branch has in the past investigated a terms of reference for a sediment study, as part of a proposal for the regional plan in 2015/2016 but the budget was too large for the department"* (Saldanha Bay Intergovernmental Task Team Stakeholder Forum Meeting, 2018).

The chairman of the SBIGTT assigned the task team to engage with the Saldanha Bay Water Quality Trust Forum (SBWQTF) regarding the sediment study and monitoring thereof.

Two points can be noted here, the first being the acknowledgment that attention must be given to Langebaan's erosion problem, because if not taken seriously, the problem will escalate. The second being the role of provincial government in partially facilitating the necessary steps to be taken in responding to this problem. However, taking into account that financial capacity remains a major barrier for the Saldanha Bay Municipality, national government need to assist. Feedback on the outcome of these matters were provided at the next meeting.

Friday, 10 May 2019

This meeting provided feedback to the problem surrounding Langebaan's erosion and maintenance thereof, given the site visit conducted by the coastal engineer and the findings made therefrom. The designated provincial environmental official and IGTT chair provided the outcomes of the coastal engineer's report which outlined how to address coastal erosion, the maintenance of temporary groynes and the way forward in developing a cooperative funding model for the temporary groynes. It was identified by the report that the groynes have been effective, additional smaller groynes are therefore needed with improved maintenance thereof (PG1; PG2; PG3; DG2' LG1; LG2; LG3; LG6, March 2019). Furthermore, the meeting concluded, *"the sediment study should include the whole lagoon and bay area [*AND] *this process will take time as buy-in is required from the various Departments and prospective co-funders. The DEA&DP will work towards developing an updated TOR [Transfer of Reference] for a sediment study and look to submitting a request for tenders to be advertised in the next financial year, taking into account budget constraints."* (Saldanha Bay Intergovernmental Task Team Stakeholder Forum Meeting, 2019).

West Coast District Municipality: Disaster Risk Register

HAZARD CATEGORY	HAZARD	HAZARD				Vulnerability						CAPACITY								
SCORE		Score: 4. Very Likely 3. Likely 2. Unlikely 1. Rare	Score: 4. Monthly/weekly 3. Every 1 - 2 years 2. Every 2 - 5 years 1. Every 5 - 10 years	Score: 4. Major 3. Serious 2. Minor 1. Negligible	Hazard Rating	Vulnerability Score: 4. Extremely Vulnerable 3. Seriously Vulnerable 2. Slightly Vulnerable 1. Not Vulnerable					Vulnerability Rating	Capacity Score: 4. Very Good 3. Good 2. Poor 1. Very Poor						Capacity Rating	Relative Risk Rating	Relative Risk Priority
		Probability	Frequency	Severity		Political	Econ	Social	Tech	Enviro		Physical Planning and Engineering	Societal Capacity	Economic Capacity	People Capacity and Competencies	Management Capacity	Institutional capacity			
Natural - Biological	Veld fire	4	4	3	11	2	3	3	3	4	15	2	2	2	3	3	3	15	11.000	extremely high
Natural - Atmosphere	Drought	3	3	3	9	2	3	3	2	3	13	3	3	2	2	3	3	16	7.313	high
Natural -Oceanographic	Storm surge	3	4	3	10	2	3	2	3	3	13	3	2	2	2	2	2	13	10.000	high
Natural - Geological	Seismic hazards	1	1	4	6	1	4	4	4	3	16	2	2	2	2	2	2	12	8.000	high
Technological - Transport incidents	Road Incident	4	4	3	11	1	3	3	2	1	10	2	2	2	3	3	2	14	7.857	high
Technological - Industrial	Structural Fires	4	4	3	11	2	2	3	2	2	11	2	2	2	2	2	2	12	10.083	high
Technological - Industrial	Social Conflict	3	4	3	10	3	3	3	2	2	13	2	2	2	2	2	3	13	10.000	high
Natural - Biological	Animal diseases	3	3	3	9	1	3	3	2	2	11	3	3	3	3	3	3	18	5.500	tolerable
Natural - Biological	Human diseases	4	4	3	11	2	3	3	1	1	10	3	3	2	3	3	3	17	6.471	tolerable
Natural - Biological	Sand dune migration	3	4	2	9	1	2	2	2	3	10	3	2	2	3	2	3	15	6.000	tolerable
Natural - Geological	Coastal erosion	3	4	2	9	1	2	2	3	3	11	2	2	2	3	3	3	15	6.600	tolerable
Natural - Atmosphere	Heat waves	4	4	2	10	1	2	2	2	2	9	3	3	3	3	3	3	18	5.000	tolerable
Natural - Atmosphere	Severe weather (strong wind)	4	4	2	10	1	2	2	2	2	9	2	3	3	3	3	3	17	5.294	tolerable
Natural - Water	Floods	3	3	3	9	1	3	3	3	3	13	2	3	3	3	3	3	17	6.882	tolerable
Technological - Industrial	Nuclear event	2	1	4	7	1	4	4	4	4	17	4	4	4	4	3	3	22	5.409	tolerable
Technological - Industrial	HAZMAT: road or rail	3	4	3	10	1	3	3	2	3	12	3	3	3	3	3	3	18	6.667	tolerable
Technological - Industrial	HAZMAT: ocean spill	3	3	4	10	1	3	3	1	4	12	3	2	3	3	3	3	17	7.059	tolerable
Environmental	Harmful algal blooms	3	3	3	9	1	3	3	2	3	12	3	2	2	3	3	3	16	6.750	tolerable
Technological - Critical	Dam failure	1	1	3	5	1	3	3	3	2	12	3	3	2	3	3	3	17	3.529	low
Technological - Transport	Aircraft incident	2	2	3	7	1	2	2	2	2	9	3	3	3	3	3	3	18	3.500	low