

An assessment of the capacity of waterfront
developments to adapt to climate change:
*A case study of the Point Waterfront Area,
Durban*

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Declaration

I certify that the work presented in this dissertation is, to the best of my knowledge and belief, original, except as acknowledged in the text. The material has not been submitted, either in whole or in part, for a degree at this or any other university. I acknowledge that I have read and understood the university's rules, requirements, procedures and policy relating to my higher degree research award and to my dissertation. I certify that I have complied with the rules, requirements, procedures and policy of the university. This work is being submitted for the degree of Master's in Town and Regional Planning, School of Built Environment and Development Studies, University of KwaZulu-Natal (Howard College Campus), Durban.

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Abstract

This research set out to investigate the resilience of the Point Waterfront Development in Durban, South Africa, with regards to climate change. Considering that South Africa is a Third World country, the assumption was that Point Waterfront area would fall short of resilience when it comes to climate change. This research made use of primary and secondary data from the Point Waterfront case study. Primary data were obtained through semi-structured interviews with key stakeholders of the Waterfront development. These are The eThekweni Municipality Planning and Economic Development units, Laurusco Developments, Durban Point Development Company and the local Ward Committee and Councilor. Secondary data were obtained through recent publications in the form of municipal reports, newspapers, internet articles, and books had the relevant data on the resilience of Waterfront developments to climate change. Findings suggest that the Point Waterfront is relatively safe unless something of very extreme nature comes along in terms of sea level rise from the Indian Ocean. All the stakeholders are aware of what climate change might do to the development but the municipality is, the findings suggest, the only stakeholder that goes an extra mile as to improve the resilience of the Point Waterfront and of the city of Durban at large. There seems to be some irregularities when it comes to funds as the municipality does not have enough to tackle adaptation on its own.

As a recommendation, waterfront developments should be approved only aftermeasures that enable them to be resilient to climate change have been put in place. Developers must ensure efforts to mainstream the issue of climate change adaptation. Policies should be put in place to formalize adaptation among residents. An example would be instituting a policy requiring every property to have a green roof.

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ABBREVIATIONS

AD	Anno Domini
CBD	Central Business District
CC	Climate change
CO₂	Carbon dioxide
COP 17	The 17 th Conference Of Parties
CSIR	Council for Scientific and Industrial Research
DAC	Durban Adaptation Charter
DBSA	Development Bank of Southern Africa
DoEA	Department of Environmental Affairs
DPDC	Durban Point Development Company
DPWMA	Durban Point Waterfront Management Association
DPWD	Durban Point Waterfront Development
DSTV	Digital Satellite Television
DUMBO	Down Under the Manhattan Bridge Overpass
EIA	Environmental Impact Assessment
FEMA	Federal Emergency Management Agency
GHG	Greenhouse Gases
H₂O	Water
ICC	International Convention Centre
KZN	KwaZulu-Natal
MOSE	ModuloSperimentaleElettromeccanico
NASA	National Aeronautics and Space Administration
NPDM	National Policy on Disaster Management
PlaNYC	Plan New York City

SANBI	South African National Biodiversity Institute
SD	Sustainable Development
SEI	Stockholm Environmental Institute
SLR	Sea level rise
SVA	Save Vetch's Association
TKZN	Tourism KwaZulu-Natal
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USAID	United States Agency for International Development
VA Waterfront	Victoria and Alfred Waterfront
IPCC WG	Intergovernmental Panel on Climate Change Working Group
UEM	Coastal and Marine Union

1. Chapter One: Introduction

1.1 Background of the study

Climate change has become a major concern affecting all aspects of life. Such a change could be defined as “a long-term shift in the climate of a specific location, region or planet. The shift is measured by changes in elements associated with average weather conditions, such as temperature, wind patterns and precipitation” (Adhikari et al, 2006). Dessler and Parson (2006) further maintain that it is an accustomed part of the earth’s natural climate shifting, which is affiliated to interactions in the atmosphere, sea, and land, together with alterations in the amount of solar radiation touching the earth’s surface. Scientists believe that the greenhouse effect is the main cause of climate change. People do not impact on climate change directly, but rather they influence the functioning of these gases in the atmosphere which through a certain sequence influences the climate, causing it to change.

According to Girardet (2008) naturally developing gases, such as carbon dioxide (CO₂) and water vapor (H₂O), store heat in the atmosphere which then results in the greenhouse effect. CO₂ is added to the atmosphere by the burning of fossil fuels such as oil, coal, and natural gas. Heat emitted from the sun reaches the earth’s surface and heats it, reflecting it back to space. When this heat tries to escape, some of it is then trapped by greenhouse gases, a process which helps in maintaining a favorable temperature on the earth’s surface. However, a problem occurs when increasing amounts of greenhouse gases are released into the atmosphere where they tend to trap more heat, resulting in the earth warming up. This trend is referred to as global warming. However, global warming is only one dimension of climate change as there are other dimensions to it.

As such, it is unfortunate that too much attention has focused on only one aspect of climate change, global warming, as opposed to climate change as a whole.

Climate change has been held largely responsible for the loss of many lives through natural disasters such as violent storms. Some of the highlights are 'Katrina', the hurricane that hit the east coast of the United States in 2005. One other extreme natural phenomenon is the giant earthquake and an aftershock *tsunami* that hit Japan towards the end of 2011. There are many other severe disasters attributed to climate change, such as the severe drought that struck the horn of Africa in the year 2011 and still persists. Scientists believe such negative weather patterns and natural disasters are a result of climate change.

As the negative impacts of climate change are expected to intensify in the future, it is anticipated that waterfront developments are going to be the most affected since sea level rise and high tides are likely to impact directly on these kinds of developments. The Fukushima nuclear plant disaster that occurred in Japan in 2011 is among examples of how close proximity to the ocean can have adverse impacts in terms of natural disasters like the *tsunami* and high tides. Had that nuclear plant been placed further inland or other mitigating measures taken, minimal impacts, if any, would have been experienced.

The province of KwaZulu-Natal (KZN) in South Africa of late has been experiencing storms which witnessed severe winds raise sea levels of the Indian Ocean significantly. For instance, in March 2007 there was a severe storm that was responsible for the damage of many valuable properties along the coast of KwaZulu-Natal. "Most of the KZN coast is relatively steep, which mitigated the damage. Ballito has one of the lowest coastal profiles in the province (between 0 and 15m a.m.s.l.), however, and was the worst affected" (Smith et al, 2007:2). Furthermore, Smith et al (2007) state that the eThekweni Municipality (Durban) coastline lost approximately 3.5 million cubic meters of sand to storm erosion (ibid).

Some cities around the world have availed technology to predict such events, and placed early warning systems that alert people as early as possible of the danger they face. Some cities have walls built along the beach to prevent damage to the nearby properties should the sea level rise. It is in the interest of this research to scrutinize the ways and extent to which waterfront developments in KZN and

eThekwini Municipality in particular, have infrastructure in place to deal with adverse weather conditions that might result from the anticipated rise in sea levels due to climate change.

1.2 Research Problem

The Point Waterfront in what is now the city of Durban was sighted by Portuguese explorer Vasco Da Gama in 1497. He 'discovered' the area on Christmas day, and named it 'Port Natal'. The explorer and his crew were the first white people to settle what is now known as the Point Waterfront (Howcroft, 2000). The area continued to be the ideal location to settle for European visitors. English-speaking colonial settlers also joined the Portuguese. The city of Durban grew from the Point and it expanded further inland to the Berea area, although the prime location of the well-off was at the Point. There were only a few black locals in the city since most preferred their rural livelihood based on livestock, a trend which continued until the white settlers began recruiting cheap labour. In order to force blacks to work, compulsory 'poll tax' was imposed, which had to be paid by blacks to the whites. Since blacks had no money, the only way to pay the tax was to trade their livestock or migrate to work for whites in towns and cities.

During the apartheid era blacks were not allowed to come into what became Durban city unless they were working, in which case they had to carry passports. In that era the Point waterfront was still habited by rich whites, who kept it in a good condition. When South Africa gained independence in 1994 a major shift occurred not only politically, but spatially as well. Independence provided freedom of movement to blacks, who were previously restricted to the outskirts of the city. Hence, whites sought new places beyond the city which was getting crowded as a result of the black influx (Local History Museums, 2005).

The rise of the suburbs saw more white settlers vacating the busy Point area for a better lifestyle elsewhere. As more people came into the Central Business District (CBD) after independence the city became so crowded that a shortage of parking spaces occurred (Reichert, 1999). The shortage posed a problem for the

business people who needed to interact with their clientele. Consequently, Umhlanga and Westville became the new prime destinations for white owners of office spaces and flats. There was flight of whites and services from the Point area while on the other hand; poor blacks thronged the same area in numbers that outmatched the infrastructure, leading to urban decay.

The new, black settlers crept in, vandalizing the area, making it less attractive and unpleasant to reside in. Since the area was no longer well looked after, the area's standards began dropping, in the process becoming home to street children, drug dealers and prostitutes, among other dwellers. The flats left behind by the rich fell into disarray in the hands of black landlords, with some of the latter acquiring the dubious title of 'slumlord' (Naidoo,2003). Buildings and old warehouses in the central business district (CBD) in Albert Park, parts of Grey Street and in the Point area have since turned into small units for rental purposes targeting either individuals or families. Heller et al (2007) claim that the individuals who pay rent to dwell in, and run their businesses from, these buildings are usually immigrants regarded as being in the country illegally, hence no legal action is taken against them. Schensul (2008) observes that the buildings are not in a condition suitable for human habitation, with minimal or no running water, illegal electricity connections, and a shortage or lack of toilet facilities.

Efforts to revitalize the area have been noticeable. However, the plan which became successful in its quest to revitalize the area launched in 1998 but has since faced complications leading to delays. According to the Durban Point Waterfront Website (2009) intentions to revitalize the area have been mooted for several decades, but it was only in 2002 that the current vision was formulated. In 2004, uShaka Marine World (the first revitalization project) was opened. The stakeholders, uShaka Marine World, UEM World, Durban Investment Promotion Agency, eThekweni Municipality, Tourism KZN, International Convention Centre, and Trade& Investment KZN, all set their objectives based on socio-economic factors.

The focus has been on reviving the Point and making it habitable again. This revitalization focuses on socio-economic aspects of the area. The eThekweni Metropolitan Municipality clearly stated in its 2003 report the vision and the above

purpose of revitalizing the Point area. One cannot help but notice a lack of environmental or climate change considerations in this development. In their report, the authors specify the intended usage of the Point Waterfront zone as follows: to accommodate an expansive dimension of recreational, shopping, business, entertainment, residential, commercial, community, servicing industrial and related activities. This was in addition to many other activities that would ordinarily be accommodated within a city environment. It is anticipated the above activities will contribute towards an establishment with a dynamic and well balanced city precinct of the highest aesthetic, landscaping and urban design quality geared to promoting the notion of African urbanism (eThekweni Municipality; 2009).

However, not much has been said about the environmental aspect of this revitalization such as the changing climate, which is a threat to waterfront developments such as the Point Waterfront. Ideally, climate change adaptation and other related considerations should have been given higher priority. This research assesses the risks involved in the lack of climate change adaptation plans.

1.3 Objectives and key questions

1.3.1 Main Objective.

This study's key objective is to assess the ways and extent to which the Point Waterfront development in eThekweni Metropolitan Municipality is adapting to the effects of climate change.

Sub-Objectives

- To conceptualize the concept of climate change and waterfront development in the international and local context, in order to have a clear understanding of the usage and applicability of the above terms they relate to the eThekweni Metropolitan Municipality;

- To inform eThekweni Municipality and the Point Waterfront area development in particular, based on international and local precedents on climate change adaptation and waterfront developments;
- Inform eThekweni Municipality and the South Africa government on the environmental risks of developments close to the seashore, which if not taken into account could ultimately prove dangerous;
- To inform similar developments in South Africa such as Cape Town Waterfront about the adaptation of waterfront developments to climate change; and
- To suggest solutions for adaptation to climate change in the in the Point Waterfront development.

1.3.2 Research Question

To what extent and in which ways is the Point Waterfront development in eThekweni Metropolitan Municipality adapting to climate change in the context of negative weather patterns affecting most waterfront developments worldwide due to the changing climate?

Subsidiary Questions

- What is the conceptual meaning and usage in practical terms: climate change and waterfront developments?
- Are the eThekweni Municipality and Point Waterfront development well informed about climate change adaptation and waterfront developments from both international and local precedents?
- Is the South African government aware of the risks involved in allowing such developments to occur without proper consideration of environmental aspects?

- Looking at similar developments, such as Cape Town, is the South African government informed of risks involved in ignoring the environmental aspect in these kinds of developments?
- What solutions could be implemented in response to the threat posed by climate change on Point Waterfront development?

1.4 Hypothesis

Considering that the regeneration of the Point Waterfront area by and large focused on the socio-economic objectives of urban redevelopment, the venture neglected the adverse effects of negative weather patterns associated with anticipated climate change. Consequently, to-date the Point Waterfront development as well as eThekweni Municipality are both ill-equipped to deal with any emergencies that might arise as a result of climate change in the Point Waterfront Development.

1.5 Structure of dissertation

Chapter 1: Introduction

This chapter introduces and provides a background to his study's research topic. To this end the chapter outlines the research problem, research question, limitations, hypotheses and research approach. The chapter also justifies the importance of the topic chosen. To this end the chapter identifies the following themes: the aims and objectives of the research; research context; detailed unpacking of the title; an outline of the scope of the study; and the dissertation structure.

Chapter 2: Conceptual Framework

This chapter provides the perspective under-guarding this research. The section also lays a foundation for the research through unpacking key concepts and theories that contribute to a rich understanding of the topic. This chapter also outlines different schools

of thought, namely, the concepts of sustainable development, climate change, waterfront developments and adaptation.

Chapter 3: International and Local Precedents of the Point Waterfront Developments and Adaption to Climate Change

This chapter draws experiences of other waterfront developments and coastal areas from around the world and locally. The case studies were strategically chosen as they have different experiences and adaptation measures for climate change. These case studies contributed to a better understanding of what climate change adaptation means in relation to waterfront developments along coastal areas.

Chapter 4: Research Methodology

This chapter deals with the research methodology applied in this study. Advantages and disadvantages of the research methodology adopted by this research are clearly outlined in this chapter. The themes dealt with in this chapter include the research paradigm, contextual considerations, research constraints, selection of the research strategy, research design and an outline of the methods used for processing the data.

Chapter 5: Findings and Analysis

This chapter captures key findings of the research, based on the analysis which gives meaning to them. This chapter also provides conclusions drawn from the analysis; in the process making sense data gathered from the fieldwork. The chapter attempts to prove how the research objectives have been met.

Chapter 6: Conclusion and Recommendations

The final chapter provides a comprehensive summary of the research study by highlighting key findings as well as offering suggestions for future research.

2. Chapter Two: Conceptual Framework

2.1 Introduction

This chapter outlines the key bodies of literature in relation the conceptualization of climate change, adaptability of beachfront developments to climate change as well as international and local trends on measures adopted by beachfront developments through efforts to adapt to climate change. The chapter specifically unpacks concepts of sustainable development, climate change, global warming, waterfront developments and adaption to climate change through exploring their conceptual meanings and patterns of their practice both internationally and locally.

2.2 Sustainable Development

In the mention of the word 'development' it is hard not to visualize destruction of the natural environment, erection of buildings, and excavation among other aspects. For long, people have been used to the kind of developments that are tangible or physical, such as building skyscrapers and road constructions, among other activities. Perhaps such notions could be blamed on the industrialrevolution which instilled the idea that for development to take place, people must exploit nature in a careless manner. The late 20th century saw change in that mode of thinking, with the state of the environment in which people became the key concern(Harris, 2000). Development is inevitable as it is human nature to develop. However, a problem lies in the way people go about the developing process. Early forms of development proved to be problematic as they were both socially unjust and environmentally exploitative. Harris(2000) argues that within the well-off countries of Europe, Japan and North America, economic growth was fundamental to the generally accepted goals of 'progress' and 'modernization', but issues of equity and social justice were of relatively little concern. Such an imbalance indicated the need for a sustainable form of development.

In this respect Sustainable Development (SD) has since the turn of the 20th century, become a global framework for development. According to the World Commission on Environment and Development (1987), sustainable development is referred to as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It has dawned on many developers of the 21st century that there is need to develop in a manner that is sustainable. The three key elements of sustainable development comprise environmental, economic and social sustainability.

Until the concept of sustainable development became popular, developments were economically driven, while little attention was paid to the social and environmental aspects of development. It is for that reason that the industrial revolution turned out to have adverse impacts on both environment and society. However, in the present 21st century context, many development ventures are under immense scrutiny to ensure that it considers all the aspects of sustainable development.

Harris (2000) argues that for a system to be regarded as environmentally sustainable it must retain a strong resource base, refraining from over-exploitation of renewable resource systems or environmental sink functions, and depleting non-renewable resources only to the extent that investment is made in adequate substitutes. According to Harris (2000) conservation of biodiversity, atmospheric stability, and other ecosystem functions are not customarily categorized as economic resources. Developments must therefore consider the environmental aspects of sustainable development. This view entails not only avoiding damage to the environment at present, but also taking into consideration likely adverse effects the environment could have on future generations. An example of this would be beachfront developments, where a thorough consideration of long term sea level changes is crucial. To explain this point further, one cannot, for example, develop on land that has been classified as flood prone.

Susarla and Nazareth (2007) argue that Sustainable Development is about maintaining equilibrium between the human need to advance lifestyles and the feeling of well-being on one hand, and on the other hand preserving natural resources, social resources and ecosystems on which present and future generations depend. Harris (2000) argues that

a socially sustainable system must achieve distributional equity, as well as sufficient social services incorporating health and education, gender equity, political blameworthiness as well as participation. The social aspect of the development has long been overlooked due to the drive and hunger for economic gain by powerful individuals. Life is a system and for that reason, each and every component in the system is as important as other components. "When we focus on the social aspects of sustainable development, we look at the issues that impact people directly and that either help or hinder the process of improving the quality of life" (World Bank, 2001:1).

For a society to function well, every individual in that society must have equal access to basic goods and services such as health, education and food among others. Gender equality is another issue that sustainable development addresses, since every development must consider the social impacts of its footprints. Overlooking social impacts of a development is dangerous in that it destabilizes the social fabric, thus contributing to a drop in the quality of life in the society. A reduced quality of life tends to be detrimental even to the development itself because for people to work, they must be healthy, skilled and educated.

When one focuses on the economic facets of sustainable development, one looks at the system that determines how the finite resources needed to improve peoples' lives are distributed, as well as to inspect closely how these limited resources are used. The economic aspect of sustainable development still has a dominant influence in the decision making (Susarla & Nazareth, 2007). Developers tend to look at the economic risks of a development rather than social and environmental. To strengthen this point, Harris (2000) argues that one must also look at economic viability of a project as this helps in preparing for costs likely to crop up in the development, and the effects those costs will have in the lifespan of that development. Developing in areas prone to climate change, impacts are likely to cost the developer in the long run. It is an undisputed truth that the world is driven by the economy and those who possess it have power over those who do not. In addition economic issues and environmental concerns are closely linked since the economy is highly dependent on the sustainable use of renewable resources. According to a report compiled by the World

Bank (2001), economic issues are also connected with social concerns. For example, short-term investment in the development of knowledge and training of workers hinders the potential for economic growth. It is for that reason that every development should include all these aspects of in its approach.

Critiques of sustainable development argue that the terms largely ambiguous and unclear, especially since it has been applied in many disciplines, each of which have different perspectives of what should be viewed as sustainable development. Economists have a different perspective of sustainable development as compared to environmentalists, for example. There has been a plethora of publications on the term, including its critiques. Some of the critiques point out that sustainable development is a way of delaying Third World countries from developing since it is extremely costly for such nations to adopt the measures required by sustainable development (Lippert, 2004). Rowney and Fergus (2005) point out that what needs to be negotiated by academics, business, and society as a whole is the loss of opportunity to engage in a compendious colloquy around the notion of developing values that lead to progress in all its differing aspects.

Over and above all it should be noted that the challenge facing the realization of sustainable development is the economic bias of developments. Both public and private initiated developments must take cognizance of the economic aspects of their initiatives while at the same time considering the social and environmental imperatives. "To some extent the term has become a cliché applied to almost anything remotely related to the business processes, the society in which those processes operate, and the environment in which both processes and society are embedded"(Davies, 2002:195). It is evident that businesses have taken a substantial stake in SD; thus they drive sustainable development according to their perspective. These negatives present an opportunity for the improvement of SD as they expose the weaknesses of the concept. Such exposure creates a platform for debate from which improvements could be expected.

2.3 Resilient Cities

Resilience as a concept was first introduced in the 1970's by a Canadian professor by the name of Crawford Stanley Holling. He used the concept in an attempt to discover how the ecology reacted when confronted by disasters or hazards. Since then, the concept captured the attention of researchers concerned with climate change. The Intergovernmental Panel on Climate Change defines resilience as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change (IPCC WG2 2007: 880). From this definition it is evident that the most concerning aspects are functioning and structure. A system is regarded as resilient if, when faced with external shocks, still maintains some degree of structure and functioning.

Climate change is one external factor that threatens the structure and functioning of our societies. Prasad et al (2009) argue that there are three determining factors for resilience in any given society, these are:

- a) The amount of disturbance a society can absorb and still remain within the state of the domain of attraction.
- b) The degree to which the society is capable of self-organization or adjustment; and
- c) The degree to which the society can build and increase the capacity for learning and adaptation.

There are a plethora of issues that come into play when one talks about resilience. One only has to look at the grassroots level (in families) in order to determine whether families possess enough assets and whether they have adequate access to services. According to Malone (2009) assets include the amount and quality of knowledge and labour available to the household, the physical and financial capital they possess, their social relations, and their access to natural resources. He further argues that services include those provided by flood control, coastal protection and other infrastructure, transport and communications, access to credit and financial systems, access to

markets, and emergency relief systems. It is for that reason that resilience varies from place to place according to the availability of the factors mentioned above. It is evident that a society that lives in abundance has high resilience to climate change as opposed to one that lives in lack.

Jordan (2010) argues that resilience is greatly influenced by the quality of urban governance and the level of infrastructure and services provided by the government. With so much inequality in the urban areas, urban governance has to be extremely effective and operate on the principles of equity to bring about higher resilience among the urban society. The most important thing is to bridge the gap of inequality when it comes to service delivery and resource sharing. This will improve resilience among the disadvantaged groups of any given society.

To strengthen resilience in urban areas, one has to apply a community based approach as this will advance the capacity of local people to respond to disasters on their own. Lack of assets and relevant institutions limit the community's ability to respond to adversity because the existing adaptation measures become weak. Prasad et al (2009) argue that in local communities, analyzing the relationships between exposure and sensitivity to climate change and climate variability, as well as the potential of adaptive capacity building and coping, are important aspects in decision making processes with regards to where investments should be made and who should make the investment. One also has to look at stakeholder engagement in order to build resilience in cities. According to Jordan (2010) there is a need to focus attention on the uneven power relations that are embedded in the multiple 'layers of vulnerability.

Resilience in cities depends on various factors which all need full attention from the decision makers. City planners together with other stakeholders need to come up with relevant decisions that will result in good policies which in turn will have the capacity to strengthen resilience, promote social equity, and provide growth opportunities for disadvantaged communities.

2.4 Climate Change

Climate change has been at the forefront of most 21st century international conferences on sustainable development. “Climate change is a long-term shift in the statistics of the weather (including its averages)” (www.nws.noaa.gov). Although the shift may be long term, the impacts on everyday lives of people are dreadful, the likes of drought, storm surges among others. There have been arguments as to what causes climate change. Some scientists point out that it is a natural phenomenon while others are convinced that one's daily activities lead to the shift in climatic patterns.

For those who are fully convinced that humans are responsible for the changing climate, they point to six gases that are released from the earth as a result of human activities. According to the Kyoto Protocol (1997), the six gases are perfluorocarbons, hydro fluorocarbons, nitrous oxide, methane, carbon dioxide, and sulphur hexafluoride. Together they are referred to as ‘greenhouse gases’. However, among these six greenhouse gases, carbon dioxide is believed to be the most monotonous in changing the climate. “Carbon dioxide is the main contributor to climate change, especially through the burning of fossil fuels” (David Suzuki Foundation, 2011:1). The production of methane is fairly a naturally occurring process which happens when vegetation is burned, digested or rotted in the absence of oxygen. Significant amounts of methane are believed to be discharged from cattle farming, rice farming, waste dumps and the production of gas and oil. One could argue that this kind of gas occurs naturally, as opposed to the other gases, and trying to control this gas would be impossible.

“Nitrous oxide, released by chemical fertilizers and burning fossil fuels, has a global warming potential 310 times that of carbon dioxide” (David Suzuki Foundation, 2011:1). Since there is not much nitrous oxide as compared to carbon dioxide that is being released from burning fossil fuels, nitrous oxide is not as effective as carbon dioxide. Climate change has undesirable consequences on the natural environment. Human beings interact directly with the natural environment, and as such they are

affected by climate change. Climate change impacts on rainfall patterns all over the world, causing floods and droughts in different areas. “Although the potential for increased temperature is the primary and best studied aspect of anthropogenic climate change, altered rainfall patterns, increased storm intensity, and more severe droughts are also predicted in most climate change scenarios”(MiRanda et al, 2011:1305). In the 21st century, there have been a number of severe storms than ever recorded before in history. The most severe droughts in human history have also been witnessed in a way similar to extreme flooding. These events all point out to one occurrence: Climate Change. The drought in the Horn of Africa which began in mid-2011, Hurricane Katrina, Hurricane Sandy, severe snows in England, among other events, have all been witnessed between the year 2000 and 2012.

These adverse weather patterns have threatened and sometimes even destroyed human life. Although there are still doubts as to what causes climate change, there is one fact that cannot be ignored; the fact that the climate is changing. Dealing with these changes has proved to be somewhat difficult. Climate change is an incredibly complex problem, with a particularly complex policy issue to address. This difficulty stems from the governance and economic costs and benefits of addressing climate change (Held et al, 2011). With this challenge comes the issue of social justice. While the climate is changing in the entire world, there are those who cope better than others. Evidence has shown that those who possess the resources to cope have been reluctant in helping the needy by placing strict terms and conditions on the funds the well-endowed lend to poor nations. Some argue that this is injustice to the needy since all evidence points out that the ones who are responsible for the change in climate are the wealthy (Roberts & Parks, 2006).

Another school of thought suggests that humans or their actions are not responsible for climate change. An article written by Sophie Borland in a United Kingdom (UK) based online newspaper *The Telegraph* (14 September, 2007), features some UK scientists who affirm that climate change is not man-made rather it is a natural phenomenon. These scientists go as far as arguing that the concentration of carbon dioxide in space is good. “The report, by the European Foundation, also argues that increased levels of

CO₂ are not a problem because it helps to increase crop yields” (*The Telegraph*, 2012:1). Science proves that the climate has been changing since time memorial. The earth has been in a sequence of cooling and warming, and it seems that, of late, there has been a warming cycle, scientists believe. Nevertheless, what stands out clearly is the fact that climate is changing with devastating impacts on people’s lives; consequently giving rise to the need for adaptation measures. In this respect the shortfall of the ‘anti man-made’ climate change upheld by scientists is that they spend time trying to prove that climate change is natural , focusing less on the issue of adapting to climate change that is at hand. Such scientists do not present solutions to human victims who desperately need them by virtue of having been negatively affected by climate change. Whether climate change is natural or man-made is something that is debatable. While there still remains uncertainty in this respect, the impacts of climatic change are real since they impact on people’s lives daily.

2.5 Global Warming

Global warming is an integral part of the present day change in climate. There are two aspects which that climate change encompasses; global warming and global cooling. Both these climate cycles impact negatively on people and their environment. There is a substantial similarity between the causes of climate change and the causes of global warming. The only significant change in climate that is currently being experienced in the 21st century is warming rather than cooling. Hence, when climate change is mentioned it is almost guaranteed that global warming will come up. According to Girardet (2008), global warming refers to an increased Earth's overall surface temperatures as a result of the effect of greenhouse gases such as carbon dioxide. Emissions from burning fossil fuels and from deforestation retain the heat that would otherwise evade the Earth. It is this form of warming that has been blamed for melting ice in the Antarctica, Greenland and the Mount Kilimanjaro in Tanzania.

2.5.1 Cyclones/Hurricanes

The last 35 years have been the uncommonly warm. Houghton (2009) argues that within these warm years, 13 of them have been in the highlight: 1995 to 2007. It was in this period that a new generation of severe cyclones came to life. In 1998, Hurricane Mitch developed in the Atlantic Basin and was responsible for the extensive loss of life, infrastructure and property damages in the Caribbean. It recorded a wind speed of 290 km/h. The hurricane was one of the new generation of hurricanes that is still on the rise, all of which is attributed to global warming. Cyclones need warm and moist conditions to develop; global warming provides these conditions through raising temperatures in the sea and on land.

2.5.2 *El Nino*

“*El Nino*, an abnormal warming of surface ocean waters in the eastern tropical Pacific, is one aspect of what is called the Southern Oscillation” (NASA, 2003). *El Nino* is responsible for changing rainfall patterns, especially in the west South American region. Warm waters travel from east Pacific to the west coast of South America. This process leaves drought in the eastern region and brings floods in the western South America. This event usually lasts for a year or a bit more . The reverse process is known as La Nina. In this process, the warmer sea surface moves from west to east, extending to the Indian Ocean. The east coast of South Africa gets affected by La Nina in that it brings above -normal rainfall. The excess rainfall brings floods to the eastern coast, causing damage in many aspects of people’s lives in the region.

2.5.3 Droughts

In the name of Global warming, severe droughts have persisted for a relatively longer time than usual. One example of such drought was experienced in the Horn of

Africa from mid-2011. All such events are believed to be resultant of global warming. There are many other climatic patterns that have been suspected to change because of global warming. Nonetheless, the patterns all amount to one occurrence: global warming.

2.5.4 Sea Level Rise

Sea level rise refers to a process where sea levels increase and goes beyond the usual boundary. Dessler et al (2006) argue that sea-level rise is a reaction to escalating occurrences of greenhouse gases in the atmosphere, and major changes in the climate at a global scale. Ice melts have also been said to contribute to rising sea levels. Scientists believe that the rising sea levels are the result of Global Warming. This is not a problem for people who live far away from the sea. However, for those who have their properties close to the coast, it is one of the phenomenon that they wish should never occur.

Warrick & Oerlemans (2002) argue that sea level rise can be caused by numerous elements. Among them is an overall rise in sea levels attributed to melting ice. There are also occasional sea level rises. These occasional occurrences pose more threat to the people than the overall rise of sea levels. Storms can raise sea levels in a matter of a few hours, likewise tides. Natural disasters such as *Tsunamis* can also raise sea levels occasionally (Khandekar, 2009). With the rise in waterfront developments, one can only imagine the impact sea level rise will have in future on the people who are drawn to these aesthetically pleasant areas close to water.

2.6 Waterfront Developments

Waterfronts Netherlands (2012) defines waterfronts as places where water meets land. It is in this edge that interactions take place. It is where one could change a mode of transport from land to water. "This edge between the water and land is the waterfront, which is often filled with marinas, ecological reserves, lively public spaces, shops,

industrial ports, and other water-land activities”(WaterfrontsNetherlands, 2012). In some cases of establishment of some coastal cities, the prime motive of those developments was to be closer to the water. Water was a key means of transportation, especially during the mercantile and industrial eras. New York, for example, was established in 1625 where the Manhattan River meets the sea. This allowed for easy offloading and uploading of goods for transportation (The New York Times, 2008).

Although the main aim of the establishment of coastal cities was to move goods, recreational uses of the edge came into play. “Waterfront development can include any combination of different land uses, and waterfront projects could be new projects or re-developments of existing waterfronts into new places” (Waterfronts Netherlands, 2012). Torre (1989) argues that the rise of industrialization led people to turn their backs on waterfront developments. However, in the 1980’s, there was an increase in the development of waterfronts. “We are now busy trying to restore what was there to begin with, but also to create even broader uses and activities that will contribute to and raise the overall quality and image of community life”(Torre, 1989: 3). Waterfront revolution has caught the attention of many coastal cities in this century.

There are various types of waterfront developments, most of which have different uses. There has been a rise in ‘mixed-use’ waterfront developments. These waterfront developments have at least two uses. In most waterfronts developments, residential land use has become common. The following are the main types of waterfront developments to be found currently in coastal cities around the world today.

2.6.1 Commercial Waterfronts

Commercial waterfronts are by and large the most common. These waterfront developments incorporate elements of fun or recreation, work and shopping (Gounden, 2010). The Point Waterfront in Durban is one example of many waterfront developments of this kind, although it also has an element of residential.

2.6.2 Residential Waterfronts

The primary land use in these waterfront developments is residential. Since residential land use needs to coexist with other land uses, most residential waterfronts end up being mixed-use. These waterfronts offer luxurious and modern quality of residential apartments which are usually expensive as compared to apartments off shore.

2.6.3 Industrial Waterfronts

These are the most popular waterfront developments. Almost every coastal city in the 21st century has an industrial waterfront. They serve as harbours; places where goods are shipped and offloaded. These waterfronts have always been an integral part of the drive to economic interaction between countries. Manufacturing companies have a tendency to locate their operations close to harbours. The primary motive is to be close to the shipping docks. These waterfront developments have been instrumental in international trade and will therefore continue to be important in the future.

2.6.4 Recreational Waterfronts

Recreational waterfronts are commonly made for leisure, often attracting people seeking relaxation and enjoyment. The waterfronts also incorporate a commercial aspect since such areas are likely to have food outlets (Gounden, 2010).

2.7 Adaptation to Climate Change

It is human nature to adapt to a changing environment. For example, people wear jackets when the weather is cold. To be able to adapt, one needs to have resources determined by the extent of vulnerability to the impacts of whatever change

happening in one's life. The Cambridge Dictionary (2012 Ed) defines adaptation as the process of changing to suit different conditions.

The climate is changing where people have for long been used to a specific kind of climate favorable to them. Climatic change, therefore, poses challenges and may even be a threat to people. Nonetheless, sometimes threats and challenges could be seen as windows of opportunity since any problem offers the opportunity for an innovative solution.

Adapting to climate change is currently among key challenges facing humanity. This is the case since climate change may be irreversible and problematic to forecast accurately (Adger et al, 2009). However, since climate change is a relatively slow process, adaptation may not be considered a matter of urgency. Some climate change events occur once in much shorter frequencies; tropical cyclones for instance. Such occurrences need immediate adaptation measures, ranging from relocating people through a measure as straight forward as building a levee.

Climate change adaptation requires resources without which it might be extremely difficult for anyone to adapt. Taking the cold weather example, for example, it will be difficult for someone who does not have something warm to wear to adapt to a cold day. Likewise, climate change needs people who have the necessary resources to adapt. Low (2005) argues that the challenge of implementing adaptation policies for future changes that are uncertain and fluid is compounded by the lack of resources in developing countries required to instigate these costly programs. Failure to adapt results in sickness, starvation and even death; evident in areas faced by naturally occurring events related to climate change. Adaptation efforts could be split into three hierarchies, namely, global governance, national governance and the grassroots.

2.7.1 Global governance on adapting to climate change

At a global level of governance, there has so far been a failure to come up with a sound and efficient international framework for handling global climate

change(Held et al, 2011). The failure of global governance means that a significant number of people in lower hierarchies suffer because of decisions made at the global level or a lack thereof. There have been many conferences on adaptation measures by the human race, and the resolutions in these conferences have been a cause of debate among the concerned parties. Since the climate change issue is closely linked to development in that developing countries are expected to be climate change cautious. One could argue that such an issue has become a political and governmental matter more than it is environmental. Depledge & Feakin, (2010) argue that the localized impacts of climate change could potentially have implications that will significantly impair the functioning of global networks on which most states now depend for their prosperity and security.

As climate change is predicted to becoming more severe over time, it could be argued that this will further impair the functioning of global networks, as climate change will be at the forefront of most intergovernmental negotiations. “As states continue to shift their strategic stances in response to projections of climate change, they will have different objectives and demands in relation to global governance structures”(Depledge and Feakin, 2010:19).Such circumstances will put pressure on global governance by elevating climate change as a priority in the global agenda. Should global governance moves slowly with regards to decision making, many people’s lives will continue to be at stake. It has also become evident that some powerful states have risen to becoming key players in determining who should develop. The United States of America, for example, did not sign the Kyoto Protocol. Based on the power the US possesses, no institution had the clout to force them into signing.

Some states such as China have also been exempted of stiff regulations on the environment because of their importance in the global economy. The world’s most promising developing economies have been able to escape, to an extent, the strict regulations because of their role in the global economy. In South Africa, Eskom was awarded a \$3.75 billion loan by the World Bank to build a coal power plant (Buthelezi, 2012). While climate change is an issue and there have been a number of outcries in favour of green development, the World Bank still manages to award a loan to such a

project as a coal power plant. “It is in this rapidly changing context that global governance structures are likely to be used by key states to determine which economies are allowed to develop, how and at what pace”(Depledge and Feakin, 2010, pg.19).

In 2011, there was a seventeenth Conference of Parties (COP 17) in Durban, which I attended by virtue of working for a research company by the name of Dalberg, I attended many sessions. What was evident among Africans attending the conference was their anger at the global community for not acknowledging that Africa is unique. This set of participants were concerned that the adaptation measures recommended did were not appropriate for the African context. Thus, such a response underlines the issue of adapting to climate change as having proved to be in closely tied to the political environment.

2.7.2 National governance on adapting to climate change

The failure of global governance in articulating the required adaptation measures has trickled down to the national governments. Most nations rely on the powerful nations of this world for the adaptation measures. A failure in the global arena means a failure on national level unless improvisation is applied in the process. Improvisation requires skills that will guarantee a successful execution of every adaptation measure. As Held et al(2011. p. 7) point out:“At the level of state, solutions have been weak and have struggled to transcend the normal push and pull of partisan politics.” However, some governments, having lost hope in the global community, have devised their own ways of adapting to climate change.

Mozambique is an example of this strategy. The Mozambican government have set policies for disaster management during floods, by applying the National Policy on Disaster Management of 1999. This policy requires the setting up of early warning systems to warn people of impending floods, besides promoting approaches to apply in immediate responses during such disasters. The government also runs flood management education among communities, which are among examples of many adaptation measures that Third World governments could adopt.

2.7.3 Grass root level adaptation to climate change

The grassroots level is crucial level when it comes to adaptation to climate change. Such a level is pivot almost natural disasters, where prompt responses are required at this level. This level consists of municipalities, communities and families among others. People have a tendency of devising their own adaptation measures since help from higher authorities is usually not as prompt as required. It is at this level where adaptation-related education for communities on issues related to climate change should ideally take place. Municipalities have different ways of dealing with climate change. Some municipalities have taken a leap through technological advancement more than others. Take Sendai town in Japan, for example which among the most affected places by the 2011 *Tsunami*. Sendai had walls reaching 10metres along the beach. The walls protected the town from being victim to a random sea level rise.

Even though these measures failed in 2011 *Tsunami*, they are a significant innovation by the municipality for sea levels below ten meters. Their failure could be justified by the fact that the *Tsunami* went beyond a worst case scenario. These innovations show that at grass root level, individuals and municipalities always have some ways of adapting. Ideally, policy makers should first to recognize the existence of these adaptation measures before imposing external solutions.

Among the most affected areas is agriculture. It is in this field that many people trying to adapt by themselves. For the sake of this research, not much detail was given for agriculture. What can be concluded from this is that, on community level, there are adaptation measures that need to be advanced by the provision of resources. Sometimes it is not that municipalities have nothing in mind, but it is because they do not have resources for adaptation.

2.8 Conclusion

This chapter explored the concepts that shape this research's perspective. The concepts explained in this chapter provide a background, and also lay some boundaries within which this research will be restricted. These concepts are crucial in understanding the issues concerning climate change and coastal areas. The following chapter takes us through international and local precedents on waterfront developments and their adaptation to climate change.

3. Chapter Three: International and Local Precedents Waterfront Developments and Adaption to Climate Change

3.1 Introduction

This chapter scrutinizes international and local waterfront developments in relation to their adaption to climate change. The main aim of this chapter is to examine waterfront developments around the world with the view of ascertaining adaptation to climate change measures and factors that contribute to their success and failure thereof. The following issues are dealt with specific reference to chosen waterfront development case studies:

- **Background of the case study:** This background focuses on the history of the area in order to contextualize all issues pertaining to climate change and adaptability
- **Climate change challenges:** This part deals with the challenges these case studies have faced, which are believed to be influenced by climate change .
- **Adaptation measures (where available):** This section will deal with the measures that have been taken to combat the adverse impacts of climate change in these areas.

- **Lessons learnt:** This section involves drawing important lessons from each of the case studies cited. These lessons will help in scaling the adaptation measures for the Point Waterfront Development.

3.2 The precedent studies

This research's international precedent studies are based on the following waterfront developments: Venice, Brooklyn and the innovative adaptation measures adopted by China and Japan. These case studies have been chosen because of their varying adaptation measures and their different locations. For local precedents, VA Waterfront in Cape Town and the coast of KwaZulu-Natal are assessed. The VA Waterfront was chosen because it is the oldest waterfront in South Africa. It is anticipated that experiences elsewhere might help the Durban Point Waterfront into becoming a successful climate change adaptable project.

3.2.1 Venice

a) Background

Venice is a city in northeast Italy. The city is made up of a sum of 118 small sized islands divided by canals and connected by bridges. It is located in the wetland-like Venetian Lagoon which extends along the sea shore between the estuaries of the Po and the Piave Rivers (Venezia, 2006). It is the capital city of the Veneto region is in the north eastern part of Italy. According to a local historic website (www.venezia.ws), Venice was established in 421 AD on April 25th, Saint Mark's day, the patron saint of Venice. During the Roman Empire era, the city was not called Venice as we now know it; rather, the name was given to the northern part of Italy as a whole. It was inhabited by people fleeing papal control and the fall of the Roman Empire. Venice city's strength was trade. However, it is not in this research's interest to focus on the history of the city, but rather on the flooding of it.

b) Climate Change Challenges

Venice continues to be susceptible to high tides which, each year affect structures adversely as they flood the city's squares. The history of Venice floods dates back to 1966. One could argue this flooding was influenced by climate change believed to have began in the late 1800 century. "An unusual combination of high tides and a relentless sirocco wind sends floodwaters surging through the city's canals and spilling over into its historic palaces and piazzas" (*The Telegraph*, 2008). It is this flood which destroyed artworks and left over 5000 people homeless, according to *The Telegraph* report. These floods hit the city again in 1986, 2008 and 2012.

What is common in all these events is that they are caused by strong storms accompanied by strong winds, and the temporary raise the sea level accompanied by heavy rainfall. In the process the inland water combine with the raised sea level, flooding the city. The city has made efforts to preempt the likely impacts of these events. With climate change is expected to bring more of such events, the city has launched an initiative to build protective measures expected to reduce the city's flooding risk.



Figure 1: Tourists having a good time in the flooded streets of Venice (November, 2012) Source : (Getty Images)

c) Adaptation Measures

Dealing with the climate change impacts has proven to be costly for every nation. Most of these adaptation measures need vast amount of finances, which are mostly in the hands of the private sector. Thus, collaboration between governments and the private sector has become vital because governments alone cannot afford the costs associated with the adaptation measures. Likewise, the municipality of Venice has sought funding from the government and private sector because of the costly adaptation measures. They have come up with a project called 'MOSE' which is an acronym for Modulo Sperimentale Elettromeccanico, which can be translated to English as Experimental Electromechanical Module.

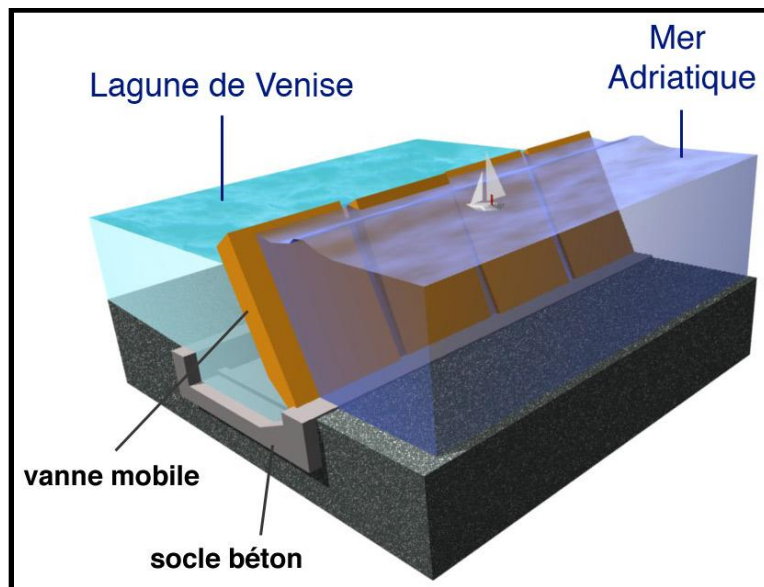


Figure2: The Modulo Sperimentale Elettromeccanico, Source (www.i-italy.org)

The MOSE (Modulo Sperimentale Elettromeccanico, Experimental Electromechanical Module) is a venture designed to secure the city of Venice, Italy from flooding. The project is an integrated protection system made up of a succession of mobile gates with the ability to separate the Venetian Lagoon from the Adriatic Sea when the waves eclipse above the recognized level of tides and the gates can rise to a maximum of 3

metres (www.cincinnati.com). "The origins of this \$4 billion project could be traced back to 1966, when the city risked being destroyed by a flood, triggering a lot of debate in the all the intermediary 34 years "(Marco, 2007:4). These walls are designed to prevent flooding in the city by blocking high tides during storms or other natural events.

d) Lessons learnt from the study

From this Venice case study, one can understand that in order to adapt to climate change, innovative ideas must be in place. The use of technological means to keep out the sea high tides proved to be an effective, innovative but expensive measure. What has been evident also is that the greater the impacts, the greater the cost for adaptation measures.

3.2.2 Brooklyn Waterfront

a) Background

The origin of Brooklyn waterfront development dates back to the 1600's when Dutch settlers inhabited the area. It was a convenient location considering that, at the time, most of trading was based on water because ships were a popular form of transportation at the time. From that time, onwards, Brooklyn became an industrial hub shipping the products to worldwide destinations. "Toward the end of the 19th century, manufacturing enterprises increased in scale. In 1890, Brooklyn had 10,623 factories, according to the Census, with 93,275 full-time workers" (Dennis, 2012:12). In the post industrial era the factories in the area were abandoned. This causing a state of decline in the former active waterfront. However, in the 1990's there was hope for the area again as the city managers planned to rejuvenate the area.

According to Dennis (2012), beginning in the 1990s, the city developed a broader plan to transform the waterfronts of Brooklyn and Queens, in New York, with a series of rezoning that permitted new large-scale residential development, as well as provisions for public access, including several waterfront parks. This effort to revitalize the area

comes with new challenges in the era of climate change. The planners and designers are faced with the immense challenge of designing with climate change in mind.

b) Climate change challenges

Brooklyn waterfront has faced a number of climate change events, some of which have resulted in flooding of the area. However, besides flooding there are other climate change impacts on that have threatened the waterfront development . These impacts deserve to be taken seriously as flooding. According to Jacob (2012), the following are the elements which the changing climate has and will continue to have an impact on in the Brooklyn waterfront development:

- Increase in the number of hot days and strong wind storms;
- More excessive rains (more street flooding);
- Sea level rise (SLR) up to +5 Ft by 2100,
- SLR in combination with;
 - a) Nor'easter winter storms, and
 - b) Hurricanes (tropical cyclones) will more often & more severely flood Brooklyn's waterfront.

According to a local newspaper, *Brooklyn Daily News*, buyers of waterfront property in Brooklyn may want to do a little more research before they put down that deposit. "A report released Wednesday says that the risk of flooding during storms in coastal areas across the U.S. is increasing faster than anticipated due to a rise in sea levels caused by global warming" (Horton et al, 2010:2). The waterfront has a history of flooding which usually occurs when violent winds raise the sea levels during storms. As storms are predicted to worsen by climatologists, the Brooklyn waterfront and New York city as a whole are faced with a challenge of coming up with adaptation

measures since vacating the area would not be an easy option. Whenever a cyclone occurs the waterfront is always vulnerable to flooding. There have been two highlights in the 2000's; Hurricane Irene of 2008 and Hurricane Sandy of 2012, among others. When it is warmer than usual people living close to the water may face sicknesses caused by rapid evaporation of sea water, which contains harmful chemicals. Violent winds and storms may damage homes besides flooding them. The reason for this concern is because being close to the sea, people are vulnerable to strong winds and storms associated with warming of the water. All these events point to the need for adaptation.



Figure 3: The Aftermath of Hurricane Sandy (2012). The streets of Brooklyn closer to the waterfront. Source: Flickr

c) Adaptation measures

“Adaptation strategies do not directly include actions to reduce the magnitude of climate change, commonly referred to as climate change mitigation, but rather, present actions to minimize the impact of climate change or take advantage of changes caused by a shifting climate” (Dennis, 2012:13). When it comes to adaptation, that is where an element of innovation comes into play. This is important because every waterfront has its priority of adaptation measures. These adaptation measures are site-specific since waterfronts are different. With a lot of valuable properties at risk,

municipalities and property developers around the world have no choice but to seek answers to the changing climate. “Our population density can often intensify the impacts of climate events, such as flooding and heat waves” (PlaNYC, 2011:156). Since population density is higher in cities than elsewhere, a storm that hits a square kilometer in the city will affect more people than in rural areas covering a similar geographic area. Waterfronts tend to be attractive areas where people flock to, especially for recreation and residential purposes. The following are the adaptation measures identified by the city of New York for the Brooklyn Waterfront:

- City and FEMA need Flood Zone Map update;
- City should update Building Code & Zoning;
- City planning needs to become more SLR proactive;
- Communities must develop long-term SLR vision;
- Early warnings, evacuation, emergency and operational preparedness;
- Avoid growth in hazard zones, retreat from low coasts and lands; restore and preserve wetland, softening shores: create vegetated buffer areas / parks;
- Raising and hardening structures (unsustainable barriers);
- Increase Capacity of Drainage / Storm Sewer / Wastewater Treatment Plants;
- ‘Flexible’ / adaptable urban design/planning and denser land use on high ground;
- Raising awareness through educational presentations for individual buildings projects;
- Flood proofing (basements, put infrastructure high above ground, raise entrances, install floodgates, raise entire structure).

(PlaNYC, 2011:12).

d) Lessons learnt

From the Brooklyn Waterfront example, one could observe the risk level the waterfront faces in relation to climate change, and innovative adaptation measures that have consequently been put in place. What can also be learnt from this study is that if action is not taken with immediate effect, human lives at risk. Perhaps among the failures of some city managers is the reluctance to act on climate change adaptation measures, with the justification that climate change has not affected that particular city. Brooklyn Waterfront has done quite well in preparing for the future, with the acknowledgement that adaptation is a process which relies on the resources for its success.

3.2.3 Shanghai, China

UNESCO and the Dutch government released a report in 2012 entitled "Coastal City Flood Vulnerability Index". In this report, they mention a number of coastal cities that are vulnerable to flooding due to climate change in Asia and the Middle East. While Shanghai was among cities that were mentioned in the report, this did not sit well with Shanghai's city managers who dismissed the document as irrelevant. The reason for that is the trust of their strict adaptation measures they have in place which then raises doubts about the flooding of the city. The report argues that once in 100 years episode of flooding in Shanghai could lead to widespread, serious damages to the city, and across China, as well as through broader financial hyperlinks for the entire world.

According to a local newspaper *Shanghai Daily* (2012), the city's flood control authority notes the area is capable of resisting typhoons and floods. The authority rejected claims that the city is regarded as being most likely to be affected by serious flooding among the world's nine key coastal metropolitan areas. The rejection of these claims is based on the knowledge of the adaptation measures that the city has put in place for climate change. The newspaper interviewed Xin, a deputy director of the Shanghai Flood Control Headquarters, who emphasized that the city's flood resistance

obstructions could withstand high tide once every 200 years, with the help of 523 kilometers of coastal levees. Xin further argued that such barriers can cope with gales of up to 133 kilometers per hour. "The levees of the Huangpu River and urban flood control projects enable the city to resist a once-in-1,000-years high tide level of the Huangpu River" (Yong, 2012, pg. 1). Although there is no consistency about the flood which the wall can resist, what is evident is that the Shanghai city managers are confident of their protective measures.

According to Yong, a daily news reporter, Hu also placed emphasis on the city's ability to evacuate coastal areas quickly in severe weather conditions. When Typhoon Haikui struck the nearby province of Zhejiang on August (2012), a total of 8 374 000 people in the urban fringe of Shanghai were relocated to safe areas within one and a half days. The reporter went further to clarify that the city is constantly upgrading its storm drainage infrastructure, installing bigger and more efficient pipes and pumps, checking seawalls and levees, and extending as required. Authorities in Shanghai are also considering a plan to build a vast, 2 million cubic-foot reservoir under Suzhou Creek that would relieve pressure on the system and gradually release rainwater after a storm (Misdorp, 2011).

3.2.4 Japan

In 2011, Japan experienced an earthquake of immense magnitude. The earthquake led to an aftershock *tsunami*. The affected people were mainly located by the sea shore. People fled to higher grounds, leaving their properties behind in the wake of the devastation associated with the *tsunami*. In their report, USAID (2011) stated that the earthquake created a harmful *tsunami* which wiped out some sections of Japan's cities; farmland along northern Japan; besides posing a threat to seaside areas bordering the Pacific Ocean. Water waves swept away houses and vehicles as frightened citizens fled the shore.

A ship carrying more than 100 people was reportedly swept away by the *tsunami*. What drew the greatest attention was the damage by nuclear plants located on the shore. If that development were further inland, it would not have suffered that much damage.

The problem with relocation lies in the costs involved in the entire process, hence a better option would be to adapt to the situation at hand. Japan has been prone to flooding for a long time, so it comes as no surprise that their adaptation measures are perhaps the most advanced in terms of engineering.

The following illustrations compare an old levee construction with the new design. The illustrations demonstrate the innovative thinking that Japan planners together with the engineers possess. A levee is an artificially raised bank built to prevent the flooding of a stream or river; a ridge of deposit placed naturally along a stream by excess water. Man-made levees are required where there is none, for example, closer to the coast. These prevent high rising water from flowing down to the people close by. There first (Figure 4) design was good , but when bombarded by water it destroys the levees since there is not enough support behind the levee.

This second design is strong as the backspace behind the levee is filled with soil and rocks to stabilize against the worst case of flooding. The good thing about this design is the usability of this 'filled up' space behind the levee. This super levee is much stronger than the first one. Moreover, the space that was not usable in the first design could be utilized by putting up a park or double storey property. The technique is to avoid situating heavy high rise buildings which will sink the back slope.

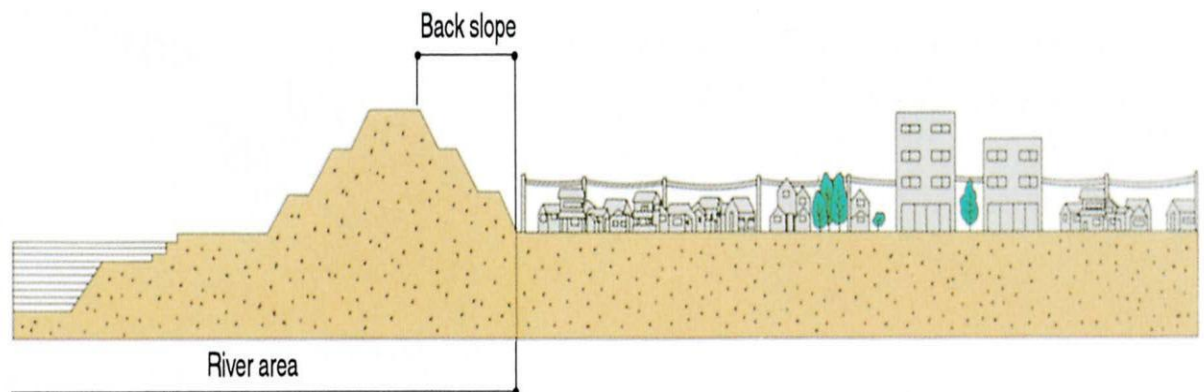


Figure4: Ordinary Levee. Source (Komada& Matsushita, 2005)

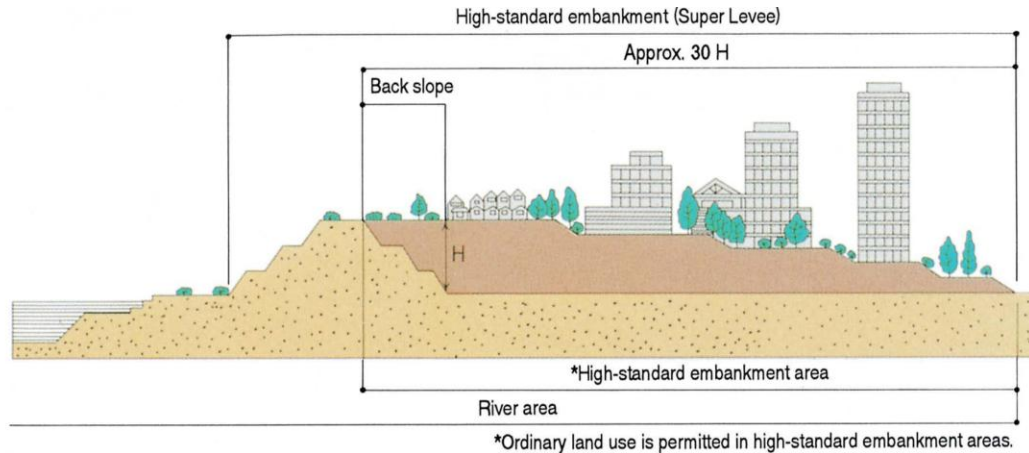


Figure5: New Super Levee (Komanda& Matsushita, 2005)

A lesson to be learnt through the above example of Japan is the innovative use of space. Instead of creating a levee that will just be there and only serve a single purpose, the Japanese came out with a brilliant design that encourages efficiency in the use of space without compromising the use value of the levee.

3.2.5 Cape Town Victoria and Alfred Waterfront

The Victoria and Alfred Waterfront in Cape Town, also known as the VA Waterfront, is the most historic waterfront in South Africa. Not only is it the oldest waterfront in the country, but it marked the entry point of the Dutch explorers into the country just over three and a half centuries ago. According to the VA Waterfront’s official website (“V&A Waterfront”, 2013), it began as a tiny jetty, designed and constructed by Jan van Riebeeck in 1654 as part of his process to set up a refreshment point at the south-most tip of the African continent on behalf of the Dutch East Indian Company. The Cape had become a place to stop for Dutch traders heading to the eastern part of Africa, India and the East in pursuit of unique products. Although the waterfront has no serious record of surging, it experienced a few difficulties at some stages of its development. In July 1858, a strong winter-time stormy weather damaged over 30 vessels. As a result, Lloyds of London, an insurance company, declined to cover ships wintering in Table Bay. On the warm day of 17 September 1860, the midshipman HRH Royal Prince Alfred,

King Victoria's second son, threw in the first fill of rocks to launch the breakwater towards Cape Town's first harbour(Campbell, 1897).

Perhaps the above-mentioned was the first and last storm that posed a serious concern for this Cape Town waterfront. Although storms occurred in Cape Town in 1984, 2001, 2002 and 2008, these did not cause significant damages to the VA Waterfront. The construction of those breakwaters and walls in the waterfront never faced some real challenges requiring serious attention. Regardless of the absence in flooding history of the waterfront, it has not stopped contemporary city planners to consider adaptation measures to cater for the unknown. This is because climate change usually brings up the unusual natural disasters, and if there is no preparation at all, much is at stake. It is for this reason that the city of Cape Town together with the Stockholm Environmental Institute(SEI) have gone all out to prepare a risk analysis of the coast of the beloved city. The report, entitled "Sea-Level Rise Risk Assessment for the City of Cape Town", was published in 2008 and prepared by Anton Cartwright of the SEI. The report explores all the relevant climate change risks, especially the ones related to rising sea level rise.

The Sea-Level Rise Risk Assessment Project aimed to present a model of the anticipated sea-level changes in the following range of scenarios:

- Model the form those changes are likely to take;
- A comprehension of the associated impacts on existent coastal environments, infrastructure and property;
- Provide assistance to, and point out the significances of, upcoming seaside developments;
- Identify risky areas that are susceptible to serious damage; and
- Endeavor to comprehend and create long-term mitigation maneuvers.

(Cartwright, 2008: 23).

One of the objectives of the above report is to offer a specific evaluation of the threats and expenses to the city and its people. Another objective is to evaluate the prospective loss of infrastructure, facilities and services from sea level increase and associated impacts of climate change between one to five century period. Municipalities tend to focus on their infrastructure because most of the properties in cities are privately owned. The report advocates that important climate change issues be tackled by all stakeholders. The report also aims to evaluate substitute techniques to deal with a variety of concerns in the forecasting of the effects of the changing climate within time frames beyond a decade (Cartwright, 2008).

The 'Save Vetches Association'(SVA) of South Africa has also contributed to the ongoing debate on coastal flooding by arguing that records before the year 2000 suggest that South African coastal areas is likely to experience waves of 7m every year, with remarkably high waves of over 10m occurring every 20 years or so. On the coast of the Cape Peninsula, the memorable hurricane and extreme storm surge of May 1984 was followed by a similar massive storm 17 years later in September 2001. Since then, the situation has changed. Waves of over 10m hit the Cape three times in this past decade; in 2001, 2002 and 2008. The global mean annual Sea Level Rise (SLR) is not the principal problem, but rather it lies in occasional high tides from cyclones and strong winds which cause significant damages to coastal property.

A lesson to be drawn from Cape Town is the need for proactive efforts aimed at generating forward-looking adaptation plans. This process of formulating such plans involves scanning the environment constantly to pre-empt the risks of not taking any action. Such efforts also helps to produce a vulnerability index to identify the most vulnerable areas. This vulnerability index helps to channel adaptation measures, firstly, to where they are most needed. Even though the above-mentioned measures have not implemented to the full, the city is on the right track towards developing adaptation measures.

3.2.6 KwaZulu-Natal Coast

Locally, KwaZulu-Natal (KZN) Province in South Africa has of late been experiencing storms in which severe winds raise sea levels significantly. For instance, in March 2007, a severe storm was responsible for the damage of many valuable properties along the coast of KwaZulu-Natal. "Most of the KZN coast is relatively steep, which mitigated the damage. Although Ballito has one of the lowest coastal profiles in the province (between 0 and 15m.a.m.s.l.), however, it was nonetheless the worst affected" (Smith et al, 2007:2). Smith et al (2007) continue to state that the eThekweni (Durban) coastal area lost an approximated sum of 3.5 million cubic meters (5.2million tons) of sand as the consequence of storm erosion.

Municipalities have become the focal point of climate change at the grassroots level. This increases the pressure on municipalities since some of them do not have the capacity to undertake responsibilities of such high caliber. As such, the decentralization of power has led to some critics pointing out that government is trying to sidestep its responsibility. "Further, by strengthening local government authorities, national policies have the possibility to leverage existing regional experiments, speed up policy feedback, promote resource acquisition and interact with local stakeholders"(Donovan et al, 2009:23). However, in this case of climate change, it sounds reasonable to place the responsibility on local municipalities as they are close to the affected people.

According to Donovan et al (2009) future trends will be formed by urban planning. Consequently, the centralization of population, socio-economic activities, poverty and infrastructure in cities will translate into an augmented exposure to climate hazards. It is evident that the municipalities have the responsibility to deal with climate change on their own. This pressure is further enforced by the new policies introduced to guiding development along the sustainable route. Within municipalities, planners are faced with an enormous challenge which entails making decisions that incorporate all aspects of society. Urbanization places an added pressure on these municipalities in their efforts to adapt to climate change.

“Urbanization has increased its pace over the last 40 years, and almost all the planet’s population growth until 2030 is expected to happen in developing countries’ urban areas”(Graeml and Graeml, 2004:3). This implies that more carbon dioxide emissions are expected to come from the Third World. This explains why the First World countries are busy enforcing the idea of ‘green development’ or ‘sustainable development’ in the development policies of the Third World. First World nations foresee increasing environmental pollution making a relatively high contribution towards climate change. Even Durban is experiencing growth, with squatter camps growing along the edge of the city as increasing numbers of jobseekers flock in steadily. The increasing rate of urbanization will affect CO2 emissions and lead to more pollution associated with urban sprawl. This trend will in turn affect the climate of the KwaZulu-Natal coast adversely. This will lead to more severe storms and cyclones with the oceans warming and evaporation happening at a high pace.

3.3 Conclusion

This chapter looked at other waterfront developments and coastal zones both locally and globally that have been under threat from climate change. It has become evident that some waterfront developments face much severe threats as compared to others, thus calling for measures to adapt to climate change in all these waterfront developments since each differs from the other. It could be assumed that climate change adaptation requires innovation and collaboration from all parties involved.

4. Chapter Four: Research Methodology

4.1 Introduction

This chapter outlines the methodology adopted to assess the adaptability of the Point Waterfront development to climate change through a case study. Two kinds of data sources have been used in this research; namely, primary and secondary data. Primary data consists of 'first hand' data that has not been previously published by some other researcher. Secondary data refers to existing data published on the topic in question. This research was based on the case study of the Point Waterfront development in eThekweni Metropolitan Municipality.

4.2 Research Design

"When constructing a building, there is no point ordering materials or setting critical dates for completion of project stages until one knows what sort of building is being constructed" (EFS, 2012:9). Likewise, every research has to have a design which will guide it to the direction the researcher wants. Van Wyk (2011) argues that the research design' function is to ensure that the evidence acquired allows one to respond to the preliminary query as unambiguously as possible. The design determines the desired outcome, hence the importance research design. Design is always associated with what one wants. When the outcome is different to the intended one, the fault is either in the design or the way in which the design was executed.

4.2.1 Qualitative Research

This study used a qualitative research method. Ospina (2004) defines qualitative research as a form of systematic empirical inquiry into meaning, qualifying systematic to mean "planned, ordered and public". The advantages of choosing qualitative research are:

- Versatility to follow unpredictable ideas during research and discover processes effectively; and sensitivity to contextual factors;
- To be able to study significant dimensions and social meaning;
- Extended possibilities such as :
 - To create empirically reinforced new concepts and theories;
 - For thorough and longitudinal examination of leadership phenomena; and
 - For more applicability and interest for specialists.

(Conger (1998) cited in Ospina, 2004)

One could contend that every method has its advantage. It all lies on what individuals are trying to find. If this research used a quantitative method, there would be a number of disadvantages and inconveniences, which does not mean a quantitative method is bad. It is all about what one wants to determine by selecting the right design. One could also reason that this research study is exploratory study in terms of purpose of inquiry. “The main aim of exploratory research is to identify the boundaries of the environment in which the problems, opportunities or situations of interest are likely to reside” (Van Wyk, 2011:4). However, this is not entirely the case; the method has an element of exploration.

4.3 The case study of the Point Waterfront development

This research was based on a case study of the Point Waterfront development, chosen because it is a typical waterfront development not only in eThekweni but in South Africa at large. In recent years the area has been undergoing severe decay due to the lack of maintenance from the people who moved into the area after the rich whites vacated it for Durban’s outer suburbs. In the past decade, however, the area has

undergone significant transformation made possible by the collaboration of the private and public sector.

Although progress has not been as swift as anticipated, some major projects have nonetheless been a success. They include the likes of uShaka Marine World, an entertainment centre, a few residential apartments, and limited mixed-use developments. However, the developers have been focusing on economic and social benefits of this development. Not much has been said about the impacts of climate change potential on the development. The results of this research have the potential to benefit not only in other South African waterfront developments but the rest of Africa also by advising developers of the dangers of such improvements in the context of climate change.

Case study research is extremely important in advancing understanding of miscellaneous issues, as well as the ability to extend experience or bring additional strength to what has already been familiarized through previous research. Case studies place emphasis on precise contextual analysis of a confined number of events or circumstances and their relationships. At present, few publications exist on such development in South Africa. Case studies provide a well-intentioned scheme of challenging theoretical assumptions. This research study is intended to contribute towards learning since its results will be one of the few that have been published, especially with the focus on adaptation to climate change.

4.4 Research Setting

Research setting refers to an area where data was collected, which in this case is Durban. Personal interviews were conducted in the respective respondents' work places.

4.5 Data sources

4.5.1. Primary data

Palys (2008) defines primary data as sources comprise information elicited from key informants for each study. The advantage of primary data is that of clarity and authenticity since the information elicited is from an original source. This research study made use of primary data for the findings.

Sampling

Sampling is an act of selecting a portion from a large population. This portion selected is taken as a representative of the whole population. Though there are many sampling techniques that one could use, this research study has chosen to employ purposive sampling.

Purposive sampling

Palys (2008) maintains that to engage in a purposive sampling technique indicates that one views the exercise as a succession of crucial choices regarding whom, where and how one conducts their research. Firstly, the sampling method has to be tied to the objectives at hand, meaning that the sample is guided by one’s objectives. This helps ensure the findings remain in line with the objectives. Under sampling of this nature this research study sampled all stakeholders. According to Palys (2008) this purposeful sampling technique is useful in the context of evaluation research and policy analysis.

This approach includes an identification of who the main stakeholders and their involvement in the research design throughout the different stages such as administration of the program, evaluation, as well as how the beneficiaries are affected in one way or another (ibid). In this case study the research employed the Point Waterfront development as the object being evaluated. According to the objectives, this research identified the following stakeholders:

Table 4.1: Stakeholders and their roles

Type of stakeholder	Type of role in the Point Waterfront development	Name of stakeholder

Municipality	Governmental role	<ul style="list-style-type: none"> • eThekwini Municipal Planning Division • eThekwini Municipal Environmental division • eThekwini municipal Economic Development Unit
Private sector	Business interests	<ul style="list-style-type: none"> • uShaka Marine World (private investor) • Laurusco Developments • Durban Point Development Company. • RocPoint Group • Durban Investment Promotion Agency • UEM World (Property Developers) • International Convention Centre

		(Private Investor) <ul style="list-style-type: none"> • Tourism KZN (development, promotion and marketing of tourism) • Trade & Investment KZN (investment promotion agency) • Durban Point Waterfront Management Association (managing matters of common interest)
Ward councilor	Community representation	Bongumsa Dlamini
Urban planning consultants	Design	IYER Designs (Urban Planners)

Table 4.1

Data Collection Tools/Instruments

There are many data collection instruments applied in research, depending on their relevance in various situations. In this research study the following data collection methods were used:

Personal Interviews

Conducting an in-depth interview is considered among the most powerful research tools. The researcher talks with the interviewee face to face at a time both of them have agreed on. Unlike in focus groups the interviewer deals only with one person (the interviewee) at a time, and therefore has control over how the interview is conducted. This research has utilized mostly this kind of data collection tool by using interview schedules. For those stakeholders who could not be interviewed directly, this research utilized questionnaires instead.

Mail Surveys

Questionnaires are convenient in that they could be answered by the interviewee in the researcher's absence. Questionnaires also allow the respondent to make provide responses at the convenience of his or her own space and time. Another advantage of this data collection tool is that some respondents feel intimidated by the presence of the interviewer; consequently, their responses might be somewhat biased. In this dissertation, questionnaires were used for specific respondents who did not have much time to spare during the day, such as the developers of the Point.

It became evident that not all of the respondents could be available for a personal interview. In this case, a mail survey was used. Since we live in a cyberspace century, these mail surveys were conducted through email. Mbambo (2009) observes that a pilot study is usually conducted before applying this method to pre-test the questionnaire. This process unveils the research tool's weaknesses, if any, prior to full-scale application of the tool. Careful preparation of the questionnaire is crucial. Pre-testing the questionnaire will guarantee the extent of its effectiveness in collecting relevant information. Likewise, in this dissertation questions that could be asked face-to-face had to be altered in consideration of the survey method being used.

4.5.2 Secondary data

Secondary data is the information collected previously by other researchers and readily available from various sources. Secondary data is relatively cheaper to gather as it is

somebody's research findings that have been published already. Such data is also more easily accessible than primary data. Nevertheless, secondary data is useful in that it provides researchers with a brief background of what is going on in a specific field of research. In the case of this research study, the secondary data sources were:

- a) Publications from eThekweni Municipality:** The municipality regularly puts out publications on climate change. This research study has used some of these publications in referencing the plans the municipality has on the issue of climate change adaptation.
- b) Journals:** Peer-reviewed journals can be very useful in that they contain reliable information on specific topics of research interest. This research study has made use of journals in a bid to understand issues of climate change adaptation at a deep level.
- c) Books:** Like journals, books have valuable information for any topic required. This research study has employed books in the review of literature and for cross referencing concerning what the eThekweni Municipality and other stakeholders, both locally and globally, are doing concerning climate change adaptation.
- d) Internet:** Sometimes not all the information required is readily available in a tangible form. The Internet plays a vital role in filling the existing gap. In this dissertation the Internet has been used for reviewing what other waterfronts around the world are doing in terms of adaptation to climate change.
- e) Newspapers:** It is rare that any natural disaster goes unnoticed by the media. Newspapers have useful reports about these events, which are also presented in pictures and videos(for online news). This research has made use of newspapers, especially in the review of literature.

4.6 Ethical Considerations

Orb et al (2000) argue that tension is often created between the aims of research to generalize for the greater good of others, and the rights of participants to maintain their privacy status. Regardless, it is important to respect the respondent's decision. Inasmuch as a researcher seeks information, some respondents choose not to answer certain questions while other select not to participate at all. In such cases the researcher is required by ethics to respect the respondent. This research did not break any of the research ethics. Instead, the research respected all the principles of research ethics.

- **Beneficence:** Refers to freedom from harm and exploitation. This research study respected this ethic, therefore no one was harmed or exploited in the data collection process.
- **Autonomy:** This encompasses respect for people and the identification of participants' privileges, such as the right to be briefed about the research, the right to easily choose whether or not to take part in a research, and the right for a participant to pull out whenever they choose to without facing any penalty (Orb *et al*, 2000). This research was autonomous to the greatest extent possible. Any information the respondent required was provided, while the decision of individuals who did not wish to take part in the research was also respected. Religious, cultural, gender and ethnic sensitivity were taken into consideration in every question directed at participants.

4.7. Analysis

Coolican (1999) argues that the information acquired from a research study may or may not be in statistical or quantitative type, that is, by means of numbers. If the information is not in statistical form, then a participant could opt for qualitative studies which depend on encounters with small groups or individual participants. This research has applied the qualitative paradigm to analysing primary and secondary data.

Coolican(1999) further notes that qualitative research concerns itself with the experiences of the participants, as well as the meanings they affix to their experiences.

Researchers employing interviews, situational research, or observations to elicit data, usually (though not always) make use of qualitative data. Banister et al (1994) argue that it could be difficult to interpret information obtained from interviews because of social desirability bias, complex interactional processes, and self-fulfilling prophecy. On the other hand it is relatively easy to work with numbers because they are always fixed. On the other hand, when working with human behaviour or response there is always room for distortion since the researcher and their subjects have personal perspectives and values. Even though that might be the case, qualitative research provides room to probe for clarity since neither questions nor answers are fixed, as is often though not always the case in quantitative research.

This research has used thematic analysis for analysing the qualitative data from the field. Braun and Clarke (2006) observe that thematic analysis provides a qualitative analytic means for determining, examining and confirming arrangements (themes) within data gathered. Thematic analysis minimally organises and explains the data set in a more detailed manner as compared to quantitative research. Thematic analysis goes further than to interpret various factors of the subject under discussion. In this dissertation the themes helped in shaping specific research finding and enabled better analysis.

4.4 Conclusion

The above section reviewed various methods applied in this research. The primary data sources were purposefully chosen as they had the key information that became crucial for the research. To back the primary data, secondary data was selected according to relevance to the study. The sampling method used was purposive sampling which helped identify key informants, while also helping eliminate ambiguity at the data collection stage. The above methods contributed to the success of the research.

5. Chapter Five: Findings and Analysis

5.1 Introduction

The past section mentioned the research model and techniques of this study. In this chapter the focus shifts to the presentation of the case study, the findings and the analysis of the findings. After a relevant research was conducted based on primary and secondary data sources, this chapter will presents the findings based on common themes and patterns in the findings. The themes help in analyzing the data in a systematic manner based on different themes that indicate climate change and adaption measures in the Point Waterfront Case Study.

5.2 Presentation of the Case Study

This section of the chapter entails giving a historical context and a brief overview of the case study. This overview focuses on the objectives of the Point Waterfront Development, also including the actors and their roles in relation to the development and the sources of funding for the project. This paves the way for a discussion of the findings and analysis grounded in the context of the Point Waterfront development case study.

5.2.1 Historical Context

The Point area played a crucial role in the establishment of Durban as a city. Before European settlers appeared on the scene, archeological remains indicate there were people who had previously lived in the area. The first European to spot the area was Vasco Da Gama. He saw the area while passing by on Christmas Day 1497, and named it Terra de Natal (Wightman, 2007). However, he did not envisage the area's potential since he never returned to settle. Another Portuguese explorer who also failed to appreciate the potential of the port was Diego Pereira, who stopped by the Point on his way back from India while heading for Portugal.

“The British settlement of Port Natal derives its origin largely from a series of events which took place farther north” (Mackeurtan, 1930:92). In 1685, a British ship named Good Hope managed to enter the mouth of the port but was later shipwrecked, leaving all its passengers stranded therefor months on end. They were not the only ones who had their ships wrecked; however, the survivors of the British ship Bonaventure and the Dutch ship Stevenisse later joined their predecessors at the port. These survivors built a ship at the Port which holds the record of being the first ship to be built in the site. The ship, which was christened Natal Packet, rescued all the survivors. The first attempt by Europeans to buy land in the Point area was made by the then Cape governor at the time, Simon Van Der Stel. He bought the land from Chief Inkanyesa, but its title deed sunk to the bottom of the Indian Ocean when the ship carrying it got shipwrecked on its way back to Cape Town.

In 1824, an explorer by the name of Henry Francis Fynn landed in Port Natal. “He erected a fence to keep out the animals” (Wightman, 2007: 7). He is regarded as the first permanent settler in Port Natal. He was later joined by Francis George Farewell who arrived from Cape Town seeking to settle around the Port. Farewell arrived at the Port on a ship named Salisbury which was said to be the first to dock at the Port. Meanwhile, Fynn visited King Shaka who was wounded at the time as a result of stabbing. Wightman (2007) claims that Fynn was able to cleanse the wound, leading to Shaka’s rapid recovery which prompted the latter to reward the white man with about 9 000 square meters of land around the bay.

In 1857 money was set aside towards solving the problem of the formation of a sand bar in the mouth of the Port, thus preventing ships entering the Port. The mayor at that time, George Cato, oversaw the process of solving the sand bar problem. He tasked a Scottish engineer to solve the problem but the latter failed to come up with the expected results due to opposition from the local government. However, all was not lost. The engineer’s efforts were terminated after he had constructed 500 feet of the North Pier, as well as the first South African Railway at the Bluff (Mackeurtan, 1930).

The second attempt to solve the sand bar problem occurred under Captain R.F. Vetch, who succeeded in constructing two breakwaters from opposing directions; leaving a gap

between them for ships to enter the mouth of the port. However, the project was terminated in 1864 due to the destruction of the breakwaters by a violent sea storm.

It was only in the late 1800's that efforts to solve the sand bar problem started to bear fruits. "Harbour engineers Edward Innes, and later Chathcart Methven, oversaw the dredging of the harbour mouth and the building of piers on either side of it" (Wightman, 2007:10). Through these engineers' efforts Durban finally succeeded in providing a deep port safe for ships and other vessels. Since, Durban has been able to expand into the city it is today. The first police station was built in Durban in 1902, followed by a fire station in 1906. The 1900's saw the Point area rising to become Africa's busiest port. The buildings that dominated the area were the buildings belonging to harbour workers and Addington Hospital.

Following the 1940 invasion of the Point by not so wealthy whites, the area began to decay. During the apartheid era no blacks were allowed into the city, which in turn led to the abandonment of the harbour workers' buildings in the Point area. The rise of suburbs in the outskirts of the city also played a major role in the decay of the Point. The owners of the land in the area were the eThekweni Municipality, Transnet, Portnet and Department of Public Works. Observing the decay in the area, all parties concerned resorted to selling the area in parcels to a single entity, a move aimed at mobilising the progress of revitalization. A steering committee was established, chaired by a local businessman by the name of Mzi Khumalo.

A number of bodies were established to oversee the rejuvenation process, identified among projects having the potential for significant economic growth, including employment creation. "Khumalo says since 1980s various initiatives had raised the potential for developing the Point area. Yet initiatives of that magnitude require substantial capital investment and no one in Durban had that kind of money available" (Wightman, 2007:28). The plan was in place but no investors were keen enough to commit to a project of this magnitude. In 1997 the project saw the dawn of a joint venture between a Malaysian conglomerate Renong and Vulindlela Holdings, who won the tender to develop the area. Renong acquired 51% of the shares while Vulindlela Holding held 49% respectively, and together they formed a company called Rockpoint.

By 1996 Rocpoint had acquired a parcel of land owned by Transnet and Portnet for R80 million and had plans to develop the waterfront to the value of R250 million. Bureaucratic delays hampered the project launch. The delays were further worsened by the collapse of the Asian economy in 2000, when Renong became cash strapped. According to the Durban Point Waterfront website (2009), intentions to revitalize the area had been mooted for several decades and it was only in 2002 that the current vision was formulated. The eThekweni Municipality launched a drive to initiate the project but Renong had no funds to contribute towards the enterprise. With so many delays, the city of Durban recognised the need for a public-private partnership for the project to go forward.

The development received a go ahead as the city of Durban entered into an agreement with Tongaat Hulett, which contribute towards funding to eThekweni Municipality for the development of the Point. From its sources the city put R407 million on the table towards the initiation of the first phase of the development (uShaka Marine World) in 2001. Rockpoint, together with the rest of other stakeholders had to contribute the outstanding amount towards the development of uShaka Marine World. With all the delays and lack of funds in the past, the public became sceptical about the project even though plans were made for the initiation of the first phase of the project. The new partnership saw the project lifting off the ground with the creation of the marketing division of the Durban Point Waterfront Development Company.

According to Wightman (2007) the public was sceptical since the marketing division had centered on changing those perceptions to show the commitment from the eThekweni Municipality, Tongaat Hulett Development and the Point Waterfront Development Company in getting the project underway. uShaka Marine World, opened in 2004, became a big break for the revitalisation project as a whole. The project began at a significant pace alongside a residential apartment which shot up the sky adjacent to the uShaka Marine World. The development was planned to have a small crafts harbour, which angered the public since the new harbour would constitute privatization of a public beach. This led to the revision of the plan which resulted in a new smaller harbour, with the proposed pier close to the north pier. While at present not all plots

have been sold and some of the purchased ones have not been developed, nonetheless progress is evident in the area.

5.2.2 Contextual Understanding

Location



Figure 6: The Point Waterfront and UShaka Theme Park. Source (DPDC)

The Point Waterfront is located at the entrance of Africa's busiest port (Durban harbour) and south east from the central business district. It offers beautiful views of the golden mile and is also home to a number of surfing clubs. On the west facing side, the Point is situated alongside the Durban harbour and Transnet terminal. The eastern side the Point faces the famous South Beach. Only a few waterfronts in the world are privileged to have both beach and harbour, and Point Waterfront happens to be one of them. Also

unique about the Point is its canal which gets its water from the uShaka Marine World theme park as discharge.

Land Use

The Point is predominantly mixed use. In these mixed use zones there are retail, office and residential uses. The retail section is mostly located on the ground floor with offices on the first and second floors, while the rest is also purely residential land use consisting mainly of residential apartments not higher than 11 storeys. The developers of the area do not like very tall apartments in the area as these will create shadows which fall on other buildings. Another concern is the view; tall buildings usually block the view of other buildings behind them while ideally, all the parties situated there should have full access to the ocean view. The west side of the Point Waterfront consists of mixed land use which could also be incorporated for industrial use. The reasoning behind the demarcation of the land use is motivated by the proximity of the land to the port. Recreational land use is also incorporated since it possesses an aesthetic value besides acting as a cooling agent for the area.



Figure 7: Land Use variety in Point Waterfront. Source (DPDC).

5.2.3 Objectives of the Point Waterfront Development

The following are the Point Waterfront development's objectives as outlined by the Durban Point Development Company, which is now known as Laurusco Developments:

- An urban center concentration of scale and an urbane identity of development.
- A structure creating unforgettable places based on pathways, water bodies, boulevards, views, city pieces/squares, avenues, walkways and recreational areas.
- A well-managed, fresh, eye-catching and protected environment;
- To concentrate on easy, secure, convenient and enjoyable pedestrian mobility with access to well located, secure vehicle parking areas;
- A focus on mixed-use improvements which motivates the incorporation of retail stores, commercial, office, enjoyment and residential activities;
- To discourage a car dominated environment; and
- Advocacy of excellence in the quality of private developments in their architectural expression, use of high quality materials, attention to design detail and above all the creation of vibrant, people friendly spaces.

(Durbanpoint.co.za, 2010)

Evident among these objectives is the lack of climate change adaptation plans. Since this is an urban renewal project, it is understandable that the stakeholders saw it fit to focus on the aesthetics, walk ability, mixed-use land uses among others. This approach, however, does not mean the stakeholders are not aware of the adaptation plans, nor does it mean that there are no plans in place for adaptation.

5.2.4 Actors and their roles

Table 5.1 below identifies key actors in the Point Waterfront Development and their roles in the overall developmental interventions in the area.

Actor	Role
1. Environmental Department (City of Durban)	An environmental division of the eThekweni Municipality. The division is responsible for environmental matters around the metropolis. The division is also responsible for drafting climate change adaptation plans for the municipality.
2. Planning Department (City of Durban)	These are the municipality's town and regional planners. The planners are responsible for land use matters within the municipality. They planners ensure that every piece of land is used as specified for the precinct.
3. Engineering Department (City of Durban)	These are the city engineers. The engineers are responsible for the city's infrastructure. They decide whether the infrastructure needs an upgrade or not. The engineers also ensure that developments occur on safe lands.
4. Laurusco Developments	Laurusco Developments are the project directors or development managers of the Point Waterfront Development.
5. Ward Councilor	A person elected by the community of Ward 26 to represent them as the voice of the people.
6. Iyer Urban Design Studio	Iyer Urban Design Studio was commissioned as Lead Urban Designers, working with a multidisciplinary team in developing the Urban Design Framework for the Point Waterfront Development

Table 5.1: Actors in the Point Waterfront Development and their roles

5.2.5 Sources of information

When one goes about doing research, there are a number of different types of information sources likely to prove useful. These information sources may either be primary or secondary. This research study utilized both primary and secondary data for the findings. Information was primary data sources were obtained from interviews while secondary data included pamphlets, internet sources, publications books and newspapers.

Source of Information	Type of information
1. Environmental Department(Durban city)	Primary and Secondary
2. Planning Department (City of Durban)	Primary
3. Engineering Department (City of Durban)	Primary and Secondary
4. Laurusco Development	Primary and Secondary
5. Ward Councilor	Primary
6. Durban Waterfront Management Association	Secondary
7. Iyer Urban Design Studio	Secondary
8. Internet News Articles	Secondary

Table 5.2: Source and type of data collected in the Point Waterfront case study

5.2.6 Sources of Funding

For projects of this magnitude, one needs reliable investors who will buy into its vision and invest huge sums of money in it. The municipality alone could not revitalize the area because of the astronomical costs involved in the process. According to the developing company's website, intentions to revitalize the area had been mooted for several decades and it was only in 2002 that the current vision was formulated. Much of the impetus for this development renewed for this initiative has been the implementation of the uShaka Marine World project (DPDC, 2009).

In 1997 the RocPoint Group and a Malaysian company called Renong collaborated with Vulindlela Holding, a black empowerment company. This joint venture went on to win a tender to develop the point area (Wightman, 2007). This joint venture then went on to purchase the land belonging to eThekweni Municipality, Portnet, Transnet and the

Department of Public Works. However, the development faced some difficulties due to the falling of the Malaysian currency. The Malaysian company pulled out of the development and it was down to the remaining parties, leaving the municipality to go ahead with the development. A total of 55 hectares of land was sold to the joint venture by the eThekweni Municipality for development (Wightman, 2007).

After the difficulties faced by the Malaysian company, the eThekweni Municipality played a leading role in ensuring the project made steady progress. RocPoint and the municipality had entered into an agreement to develop the 55 hectare site situated at the port of Durban, Africa's busiest port. It was the city's burden to raise the capital needed for the first phase of the development. The city was able to raise the required funds from the public and the private sector. According to Gounden (2010) the city approached the Tongaat Hulett Group under which Moreland Developments was their property. The eThekweni Municipality's persistence eventually paid off when in 2003 the city authority managed to raise the R735 million which was invested towards the development of uShaka Marine World. According to Gounden (2010) the theme park would occupy 10 of the 55 hectare site, leaving 45 hectares of prime land on which to develop the Point Waterfront.

So far sums of money amounting to approximately R2.5 billion have been invested in the development of the Point area infrastructure including uShaka Marine World. Approximately R750 million of the R2.5 billion was invested in the uShaka Marine World alone, while the rest went into the development of the infrastructure in the Point area (DPDC, 2010). According to Property24.com (an online real estate company), with an approximate R1.8 billion already spent on establishing the infrastructure and complexes, apart from the R735 million used in developing uShaka Marine World, land and development favorable circumstances exist for investors who tend to become part of the prospective R6 billion development which will create one of South Africa's newest and most prestigious mixed-use environments.

“Reports indicated that the Point development would bring R20 billion into Durban's economy as well provide 23 000 new jobs” (IOL, 2011). With such potential the Point Waterfront is a viable project requiring careful planning so as to minimize losses and

bring about success. Secondary data indicates that it was the municipality that made the first move by developing uShaka Marine World using its own funds, together with help from the Development Bank of Southern Africa.

5.3 Findings

A number of relevant stakeholders were interviewed using the methods outlined in the methodology chapter. Some of the information was obtained from secondary data sources. This chapter presents all the data obtained from semi-structured interviews and secondary sources. All the respondents were asked questions relating to the adaptability of the Point Waterfront development to climate change. The responses differed slightly from one respondent to the other but overall, the respondents provided similar information. They all shared knowledge of what climate change is, and recommended adaptation measures to be put in place. The findings are grouped into themes with respect to the various facets of adaptation to climate change vis-à-vis the Point Waterfront development.

5.3.1 Adaptation to climate change

Adaptation to climate change is not an easy task since it includes unanticipated occurrences. However, there is a need to prepare for the unknown to avoid future disasters. Adaptation is a complex process as it involves all the stakeholders who have a stake in certain aspects of the development. Low (2005) advances that the challenge of implementing adaptation policies for future changes that are uncertain and variable, and is compounded by developing countries' lack of resources to instigate the costly programs. It is also evident that adaptation is a multi-faceted process which cannot be dealt with from one perspective. Likewise, this research found that the Point Waterfront Development had the following four aspects of adaptation crucial to the entire process: infrastructure, as well as accompanying social, environmental and economic aspects.

Infrastructure Adaptation

All the stakeholders agreed that the infrastructure in the eThekweni Municipality is, like other sectors, facing an immense challenge. This is because the storm surge of March 2007 did much damage to the municipality's infrastructure, costing the city millions of rands to fix the damage caused by the violent storm. The municipality seems to be the only party concerned with infrastructure. This is understandable because they have invested sums of money to the infrastructure of the city as a whole. Other stakeholders are aware of the damage that might happen to the infrastructure but are less concerned because it is the municipality's responsibility to look after it. Within the municipality, it is the engineering department that bears the burden of looking after the city's infrastructure.

Findings suggest that the biggest threat to the infrastructure in the Point area is flooding. Such floods are the result of heavy rainfall coupled with rising sea waves. If one considers the global average rise in sea level, the Point area is still safe. According to calculations by the city engineers, the annual sea level rise in Durban is 2.70 mm, which in 100 years, assuming it continues at the same rise rate, will be 270mm. For the Point area, the engineers have projected a 300mm rise in the next 100 years. This gives the Point area a breathing window of 30mm in 100 years' time. This 30mm rise has also been put forward to account for any changes in annual sea level rise in 100 years' time.

In terms of adapting to excess rainfall and sea level rise, most stakeholders highlighted the importance of the drainage system. The drainage system in the Point area is like a ridge; it drains to the beach in the front side and also drains towards the harbour in the back. The design is a standard 'underground pipe' drainage system but with the Point area, the engineers also provided for overland flow routes to assist as back-up when the underground pipelines get overloaded. The drainage system is designed for a 1:35 years' storm, when the drainage will also be assisted by overland flow routes. At present the water surface of the canal system at the Point Waterfront is four meters high above sea level.

The permeable nature of the soil in the Point area further reduces the likelihood of flooding by absorbing some of the excess rain into the ground. Stakeholders highlighted that the drainage system is upgraded when there is a need to do so. The upgrade is

usually based on climate forecasts by weather services. Forecasts suggest an increase of 10% in rainfall in and around Durban and the city engineers are now in the process designing towards a 15% increase, leaving a 5% margin for uncertainties. The Council for Scientific and Industrial Research (CSIR) works closely with the municipality, providing updates of wave height every 30 minutes. CSIR records wave heights in all of South Africa's ports. Such records can offer 6-12 hours of prediction of wave heights.

Concerning other types of infrastructures, city engineers highlighted adaptation measures planned to ensure that new or improved infrastructure such as roads, electricity lines, or landfills are not positioned in flood-disposed, low lying or coastal areas. The measures are also meant to guarantee that the materials and designs used account for ascending temperatures and extreme weather conditions. Other interventions comprise promoting the use of public transport such of bus and rail systems through upgrades, inducements and development of knowledge to lower greenhouse gases (GHG) emissions. The interventions are also geared to lessen demands on road systems, and also lower energy demand in new developments. The above second measure could be achieved through the encouragement of efficient design and technologies such as on-site renewable energy production.

The city also has been promoting the use of tanks for rain harvesting and reduction of flooding. The coastal setback lines are frequently revised in accordance with the climate forecast.

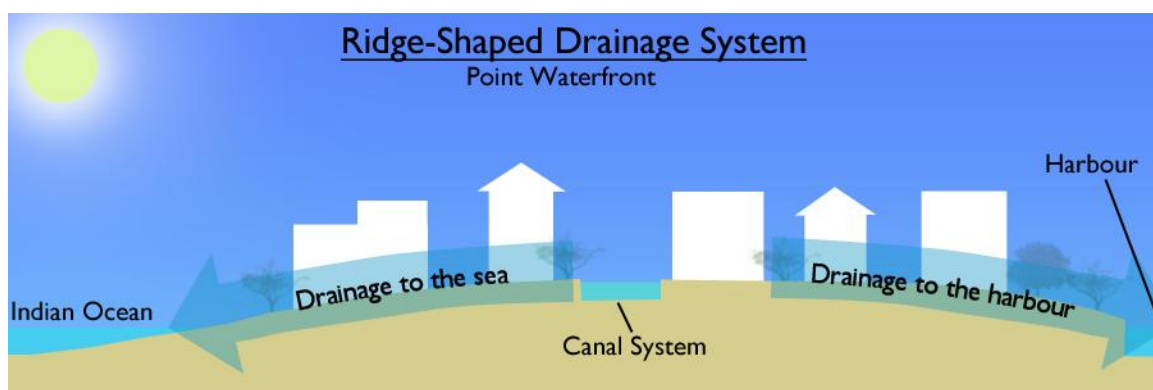


Figure 8: Ridge-shaped drainage system of Point Waterfront. Source (Illustrated by ZukisaSogoni)

Social Adaptation

Climate change does not only affect the infrastructure but does also affect the society and the way it functions. Climate change adaptation measures force people to adjust their everyday activities to accommodate the alteration. The municipality has been solely responsible for reaching out to the society and by suggesting adaptation measures. Findings show that the general public has been offered information as to what action to take when disaster strikes, and how to reduce the impact of the disaster. The public has also been made aware of what to do in scorching weather (reduce physical exercise, consume liquids, and stay indoors, among other measures).

The people of the Point area have also been repeatedly encouraged to attend public meetings and awareness raising programs. According to the councilor, 60% of the Point area residents attend these meetings and awareness raising programs. In terms of early warning systems, most stakeholders highlighted the importance of the mass media in reaching out to the public. People are encouraged to listen to the radio and watch television in the above respect. South African Weather Services also has a channel on Digital Satellite Television (DSTV) about sea level rise matters; residents are encouraged to watch the channel. The municipality also organizes educational expeditions about heat stress, and environmental health issues associated with the changing climate. These awareness programs are usually held in public areas like the City Hall and the Durban International Convention Centre.

The municipality has also been working on green roofing projects. The project promotes the use of free spaces on the roofs to grow vegetables and other plants, aimed at helping community members sustain themselves while reducing the coverage of hard surfaces. However, this venture is still a pilot project and it hasn't been implemented throughout the city.

Environmental Adaptation

In terms of environmental adaptation, most stakeholders pointed out that the study had already been done in a form of an Environmental Impact Assessment (EIA). The EIA forced the development to mitigate environmental damage as much as possible. There are now no major issues regarding environmental adaptation because the area is close to the port, and is a built up area. The element of greening the area has not been pushed to the forefront as other aspects. On paper, the whole development is visualized as having lots of green spaces and even green roofing. However, findings suggest that it is up to the property owner to decide whether they want their buildings supporting the green revolution. The developing company and the municipality cannot force individuals into cultivate green roofs on their buildings. The developing company can only plant trees in public areas like sidewalks and parks.



Figure 9: 'Greening' the sidewalks in the Point Waterfront. Source (www.cherishonline.co.za)

Economic Adaptation

Findings suggest that climate change poses a threat to the development and those threats tend to be costly. The development is said to have a potential contribution of R6 billion annually to the municipality, a sum that could contribute significantly to the economy of the municipality as well as KZN province as a whole. With such potential,

the Point is a viable project which will cost extra money as developing standards are being revised to cater for the changing climate. The revision ought to be done in a careful manner so that investors will not be put off by the strict standards put in place. Information from the stakeholders suggests that some property owners seek coverage from insurance companies. These insurances also cover for climate change induced damages.

5.3.1 Funding

When one talks about adaptation to climate change, there is a need to consider sources of funding towards the proposed adaptation plans. Findings suggest that ideally in the Point area, all the stakeholders need to be involved in sourcing funds for the adaptation plans. The developer, city and civil society all have a say in adaptation measures. Right now there are no specific funds that have been put for use in the adaptation measures. The budget that the municipality has in order to run coastal management benefits the Point indirectly. Since the Point lies in a coastal area, it features somehow in coastal management plans. The protection of the beach, for example, benefits the Point Waterfront because it lies along the coastline.

Findings suggest that the funding required for climate change adaptation measures in the Point area has not yet been put aside, though the municipality still upgrades its infrastructure to cater for climate change. The infrastructure in the Point benefits in this manner. The developing company is concerned with selling the land to property developers, who in turn are responsible for putting aside their own money to protect their properties from climate change induced damages. From this scenario, one could conclude it is an “every man for himself” situation whereby each stakeholder looks after their specific investments within the whole project.

5.3.2 Participation

The environment department of the eThekweni Municipality acknowledges that at present the adaptation plans require a lot of one on one interaction and plenty of time to generate sound solutions. These one-on-one interactions are minimal due to the fact that stakeholders have not come out in full support of the agenda as expected. Findings suggest that the municipality is the only pusher of this climate change adaptation agenda. They are the ones who are mainstreaming it into their own thinking and decision making. Other stakeholders are concerned with their own interests and less concerned about climate change adaptation plans. Public pressure has also influenced decision making in the area. An example of this is the small crafts harbour which in the past have faced severe contestation from the public. At the end of the day, the decision to redesign the small crafts harbour was public driven, with the public fighting for its own interests.

It has also been highlighted by some of the stakeholders that certain decisions that might appear to be in favour of climate change adaptation are economic driven rather than being motivated by adaptation planning. There is still an outcry by the municipality prompting all the stakeholders to come together to tackle this issue. Some stakeholders pointed out that despite much debate; no concrete solutions have been reached leading to action. Findings show that a good climate change solution only becomes successful if it will bring about economic gain, or at least does not subtract from available funds. What was also mentioned by some stakeholders is the issue of uncertainty in terms of the roles each stakeholder must play in the adaptation measures. This is not only a local problem, but rather a global problem. There are still no clear boundaries to demarcate roles to different players in matters dealing with climate change adaptation measures.

Allplot owners in the Durban Point Waterfront area are compelled to become members of a non-profit company called Durban Waterfront Management Association (DWMA). According to the Durban Point Development Company's website, the association's responsibility lies in managing matters of common interest among all lot owners including security issues, landscaping and beachfront sustenance, aesthetic and signage controls and urban management standards in addition to those

commonly provided by the eThekweni Municipality. The Association is also accountable for managing the design review process under the patronage of a Design Review Panel on development of all sites (DPDC, 2010).

5.4 Analysis and discussion

This section presents the data analysis and interpretation of the above mentioned findings, whose basis is thematic interpretation of findings. Thematic analysis identifies, analyzes and reports patterns (themes) within data. It organizes and describes, minimally, relevant data set in rich unusual way. Nevertheless, it goes further to interpret varied facets of the research topic. "A theme captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set" (Braun and Clarke, 2006:82.)

The intention of this study was to assess the capacity of waterfront developments to adapt to climate change, employing a case study in which the Point Waterfront Development was used. Based on the findings, one could argue that the Point Waterfront is adapting to climate change. This, however, is not totally true. Fortunately, Durban is located to the Indian Ocean western side of, which is not tectonically active. This means that there are minimal chances of experiencing catastrophic natural events of high magnitude as *tsunamis*. However, this virtue does not guarantee laxity of vigilance among Durbanites since the Indian Ocean is relatively warmer than other oceans. With climate change predicted to raise the global average temperature, forecasts point out to the Indian Ocean getting warmer. This will mean more storm surges, tropical cyclones and faster sea level rise.

This entire forecast does augur well for the infrastructure of the Point Waterfront Development in particular, and of the municipality since the infrastructure will need extensive upgrades. In the year 2007 when the earth, the sun and the moon were in alignment, higher than normal tides were witnessed. This event coincided with a tropical cyclone which was responsible for a storm surge. Much damage occurred

along the north beach but the Point area, located in the South beach, did not suffer as north beach did. This proves that the ridge shaped design of the drainage system at the Point was working. One could also argue that the Point is slightly higher than north beach when considering the extent of damage done in either area.

The design of the Point Waterfront area gives evidence that the small crafts harbour and the properties close to the shore are at most risk. It is predicted that the event of 2007 might happen again but chances are minimal. Although the municipality has set back lines for the shore, these lines are for general sea level rise. If the setback lines were to cater for cases such as the one in 2007, a lot of already existing property would be required to relocate. "Best international practice in the face of sea-level rise and changing coastal dynamics is a managed retreat away from the shoreline" (Department of Agriculture and Environmental Affairs, 2010). The normal Durban high tide is only 2m, while storm surges could push this further to between 5 and 8 meters. Vulnerability mostly lies along the beach where the built environment is positioned too close to the shoreline and the high-water mark. Huge sums of money were commissioned for a clean up after the storm vandalized the infrastructure along the beach.

All the stakeholders are aware of the sea level projections. The findings show that CSIR was asked to model these extreme cases in their test labs located in Stellenbosch. The Point Waterfront was able to pass the tests which were based on climate forecasts by the South African Weather Services. Since the Point Waterfront is designed to handle sea level rises over a period of 100 years, it seems as if the area is relatively safe. Its drainage system can handle a 1:35 year's storm, meaning the area's drainage system will perform well under those circumstances. One must also note that in those circumstances, the drainage system would be assisted by the overland flowing routes. However, the properties and the infrastructure closer to the shore are by no means safe from such storms. The inland properties and infrastructure in the Point area have the ability to cope with such storms due to the permeability of the soil and the geological design of the area.

Sea level rise and high tides are not the only catastrophic climate change events that have the ability to devastate the Point Waterfront. One also has to look at the amount of rainfall which the area can handle, and consequent repercussions to the infrastructure. The findings suggest that in terms of rainfall increase, Durban is expecting a 10% rise. The city engineers are on a mission to upgrade the existing infrastructure to accommodate 15% increase of rainfall. The justification given is that there must be breathing space for the infrastructure while performing under the predicted changes. If the design is to cater for exactly 10%, the infrastructure would be operating at its maximum tension which could be dangerous.

Adaptation also refers to the reduction of the likely impacts of climate change by changing the customary ways of doing things. The city and the developing company have all agreed to make the area cycle friendly and walk-able. They also encouraged the use of public transport through the design. All these efforts are to minimize the Point Waterfront's contribution to climate change, since less car means less CO2 emissions. Since the project is still approaching 50% completion, it is impossible to draw conclusions on the success and failures of the municipality's efforts to discourage the use of private vehicles.

One could deduce that in terms of infrastructure, the Point Waterfront is currently able and would in future be able to cope with the predicted normal climate change events. One also has to bear in mind that the municipality runs frequent checks on the forecasts to determine whether there is need for the infrastructure to be upgraded. An exception applies to the infrastructure and properties that will be close to the sea shore because storm surges have the potential to generate high waves reaching up to 8m high. It must also be noted that the Point Waterfront is still an ongoing project, and that some conclusions can only be drawn when the project has been completed.

It is in the public's instincts to respond to change, a measure that always brings comfort. In the society, there are things that people do and these are threatened when an external factor brings change into the functioning of these particular elements. In the case of the Point Waterfront there are a number climate change factors that force the society to adapt. The findings show that the people of the Point area have been given

the chance to learn how to adapt to climate change through meetings and public gatherings organized by the municipality. Such gatherings have proved very useful as they provide pamphlets and other forms of publications explaining how everyday activities need to change in order to cater for both the ongoing and anticipated climate change.

Encouraging the use of public transport brings a slight change in the people's social life. Some of the residents or property owners have their own cars, but the promotion of public transport through certain incentives brings about a change in one's everyday social life. One could argue that these efforts are not enough because there is still the freedom to choose. For example, if the municipality decides to raise parking prices over private vehicles, a significant share of the people would still be able to afford the new prices. At the end of the day, it is up to individuals to make a responsible decision for the betterment of the whole society.

The municipality has put in place early warning systems which give notifications of upcoming extreme weather events. Such notifications are also available through the mass media; television and radio. These efforts aim to ensure that the Point Waterfront society is kept up to date with regards to weather-related extremes. The use of public signs in times of unfavorable weather has proved to be working as it has helped the people in making them aware of the harsh weather conditions. This was evident in the 2007 storm when Allan Jackson, a Durban resident, was quoted in his website as saying: "Passing through the Point Yacht Club around the middle of March 2007, I saw a notice that higher than usual tides were expected over the weekend. Others around town had heard the same, and it was put down to the fact that the earth, moon and sun were going to be in alignment, making the spring tides more severe than usual"(Jackson, 2007). His testimony further emphasizes the usefulness of communication tools in our society to warn people of certain dangers.

The green roofing pilot by the municipality will be of great use if it succeeds. The project will not only provide towards food security but also the reduction of heat emitted by hard surfaces. This will be an effective project if only all the stakeholders in Point Waterfront could embrace it. The problem is that while there are plans to be put on the table, few

people actually act on them. Findings suggest that an EIA was conducted prior the development, and climate change was among the considerations in the EIA. The EIA dealt with most of the issues that were raised by the public and other institutions regarding climate change, and consequently the development was forced to make some changes to its designs. A total of fourteen appeals were filed against the Department of Agriculture, Environmental Affairs and Rural Development (DoEA). These appeals were against the development of certain parts of the Point Waterfront, especially the ones closest to the coast.

All of these complaints were taken into account and some solutions were agreed upon. “the coastal engineers are confident that the SCH technically feasible and that they will be able to create conditions which will enable the SCH to function effectively and efficiently in terms of a small crafts harbour”(Environmental Impact Assessment/4451: 20). According to the EIA report, tests simulating extreme storm conditions have been conducted. The report draws further attention to additional tests which also simulated for a 1:100 year’s storm. According to the EIA report, these elementary assessments show there is a limit on the wave size that could approach a harbour due to protection created by the port break waters, as well as the Limestone Reef and Vetch’s Pier formations.

No signs of any structural damage were found under these conditions. Although the small crafts harbour lies below the high water mark, the engineers of the project came up with a plan. The plan puts forward a design of additional piers to protect the small crafts harbour from the waves. This information corresponds to that put forward by the respondents. Structures will be built on the seaward side of the building development zone and as such, these structures will need to be designed to withstand potential scour and/or have sufficient shoreline protection from extreme storm conditions.

To make the area less hot in sweltering days, the designers are advocating for a green area through design and landscaping. The DPDC argues that the challenge lies in greening that augments the sub-tropical nature and microclimate of Durban Point while concurrently presenting an ecologically perceptive solution, given the circumscriptions of adjacency to the sea. The DPDC further recommends that texture, form and colour of the plants must be of a nature that is conventional to the Durban region. Ideally, these plants

will not only enhance the aesthetics of the Point Waterfront but will also serve as a form of heat reduction, including providing shades for the people.

Environmentally, one could argue that the Point Waterfront is adapting fairly well although there is still room for improvement. As the findings have suggested, the area is not very environmentally sensitive except for areas close to the shore. One could also reason that the piers that will be constructed in small crafts harbour will protect it from violent waves, in keeping with the test simulated by the CSIR using a 1:100 year's storm scenario.

The success of every project lies in the resources available for it. The Point Waterfront is a large project and huge sums of money have been poured into the development by the stakeholders involved. One cannot speculate on the costs of climate change adaptation measures in the Point Waterfront area due to the fact that the project has not been completed. For that reason, so far no figures have been presented to stakeholders concerning the costs of adaptation. What is evident is that some investors have sought out insurance cover for the unanticipated climate change extreme events.

As climate change is predicted to worsen in the future, the Point Waterfront will need some funds put aside for use when disaster strikes. The DWMA could play a major role as the facilitator in gathering these funds towards climate change induced damages. At the moment the DWMA raises funds in form of levies and financial penalties to assign officials or companies to carry out services. Using the same strategy, all the stakeholder might be persuaded to raise funds for climate change protection in the Point Waterfront Area.

All the stakeholders concurred that funding is a big issue hampering the implementation of climate change adaptation measures. Among the stakeholders it was evident that the municipality is the only stakeholder serious about climate change adaptation measures, evident through its effort towards implementing such measures. This is because the beachfront is the municipality's gold mine through tourism. The municipality has gone all out in efforts not only to implement adaptation measures, but also to mitigate the likely

impacts of the changing climate. To this end the municipality has produced a document called the Durban Adaptation Charter (DAC).

In the document the municipality mentions its plan to provide the authority's climate change financing through sourcing funds internally, as well as by seeking the advancement of various contemporary financing apparatus that make direct access to national and international funding a possibility for certified adaptation actions. The document also states that the municipality supports the establishment of a local thematic window for adaptation through the Green Climate Fund, and in so doing will require the backing of national governments and multilateral funding entities. The South African National Biodiversity Institute has been accredited as a national administering body for the United Nations Framework Convention on Climate Change (UNFCCC) Adaptation Fund. The funds required for adaptation can be accessed through SANBI by institutions prepared to work towards climate change adaptation.

There are a couple of projects that have been undertaken by the municipality to benefit the Point Waterfront area. The costs of these projects are accounted for by the municipality. The first project is titled "Sea Level Rise Assessment" which cost the municipality R500 000 (eThekweni Municipality, 2011). The money was earmarked for assessment only and not for implementation. The other project that the municipality embarked upon, entitled "Durban Ventral Beachfront Dune Rehabilitation", costs R6 million and continues to cost 1.5 million per year in maintenance. The project protects the infrastructure against wave surge and climate change induced sea level rise. In this respect no clear information on funds for climate change adaptation from other stakeholders has existed. This lack could be attributed to the fact that the project is still ongoing. A respondent belonging to the developing company clearly stated that climate change matters are being dealt with mainly by the municipality, and it is anticipated that everything will be clear on completion of the project. From the findings, one could adduce that the municipality is the sole stakeholder in the lead by making effort towards, and sourcing funds for, climate change adaptation.

When one views adaptation to climate change, stakeholders cannot afford to ignore the issue of participation. A report compiled by eThekweni Municipality advances that a bid to

address climate change effectively requires rapid and radical transformation by both societies and government structures, is mandatory. It has also been noted among respondents that participation is seen as a critical component of climate change adaptation. The findings indicated that about 60% of the population of the Point Waterfront is actively engaging with other stakeholders in sharing knowledge about what to do towards adapting to climate change. The municipality usually organizes some meetings where the Ward could interact with the municipality and other stakeholders towards sharing information on climate change adaptation measures. Some of the publications that stakeholders get from these meeting are written in isiZulu, which is convenient to those unable to read English. Findings show that the municipality bears the role of being the number one role player in ensuring that the environment for stakeholder participation is well prepared.

Throughout this research, findings have continuously shown that the municipality is investing the most efforts as compared to other stakeholders. The developers have shown less concern over climate change; instead being mostly interested in pushing developments to the finish line. Drawing experience from other waterfront developments around the world, it is evident that ideally all the relevant stakeholders should participate in decision making. For climate change adaptation to be effective there is a need for every stakeholder to participate fully.

5.5 Conclusion

This section presented an analysis and discussion of the findings. The analysis has shown that adaptation to climate change in the Point Waterfront is in place. One could argue that, to an extent, the Point Waterfront is ready for climate change. However, the analysis also revealed that there are still certain aspects that need to be improved on in order for the Point Waterfront area to fully have the innate capacity to adapt to climate change. The findings indicated that the municipality of eThekweni to be the only stakeholder making efforts to instill the idea of adaptation towards other stakeholders' way of thinking. Much still remains to be done to bring all the stakeholders to one accord towards mainstreaming climate change adaptability on every decision-making

relating to Point Waterfront. If climate change goes along the predicted pattern, the residents of the Point Area could rest confident of the planned adaptation measures that have been put, or a yet to be put, in place. However, the same cannot be guaranteed concerning the properties close to, and below the high water mark. On the whole, one could conclude that to a certain extent the Point Waterfront has the capacity to adapt to climate change.

6. Chapter Six: Conclusion and Recommendations

6.1 Introduction

This research set out to assess the capacity of waterfront developments to adapt to climate change. A specific local case study was chosen to capture the essence of climate change adaptation locally. The aim of the research was to assess the ways and extent the Point Waterfront development in eThekweni Metropolitan Municipality is adapting to the effects of Climate Change. Chapter 1 gave an overall introduction to the research while Chapter 2 looked at the conceptual framework of the research. The second chapter outlined the key bodies of literature bringing together a collection of linked ideas and concepts that shaped the thinking around the research. Chapter 3 dealt with the intricacies of international and local waterfront developments. The chapter examined waterfront developments around the world in order to learn through comparison and cross reference adaptation measures to climate change. Chapter 4 presented the methodology applied by the research study. Chapter 5 focused on the research findings and analysis on the Point Waterfront Development case study.

6.2 Reflections on the research

The research started by defining the key concepts that were crucial in constructing the main focus of the research. The methodology used proved to be applicable in eliciting the required findings. Generally, waterfronts around the world have been doing well in terms of preparation for climate change extreme weather events. The Brooklyn Waterfront in New York is an example of how all the stakeholders, if working together, have the ability to tackle climate change uncertainties effectively. The innovative designs used in Venice, Italy and in Japan also proved that climate change adaptation requires an element of innovation and creativity for the entire process to be effective.

Each waterfront around the world faces its own unique challenges and therefore there is no universal way of adapting to climate change for waterfronts. This research has shown that adaptation measures depend on the magnitude of the likely impacts of

climate change. Some waterfronts have proven to require urgent adaptation measures while some do not fall into that category. It is also important to note that adaptation measures in the First World are likely to be better than that of the Third World. The reason for that is because in the First World, there are abundant resources, including skills, while in the Third World there is still a form of dependency to the First World in the above respects.

It has become a challenge to draw up certain conclusions on the Point Waterfront in Durban because the adaptation project is still not complete. One could argue that adaptation measures for the Point Waterfront will only be effective after the project draws to an end. Nonetheless, this dissertation's research was able to find important information about climate change adaptation measures in the area. Using a thematic analysis, this research study recognized that adaptation to climate change at the Point Waterfront area could be classified under the following four categories: infrastructure, as well as social, environmental and economic adaptation.

In terms of infrastructure adaptation, one could argue that the Point Waterfront is adapting, considering the efforts invested by the municipality to ensure the city's infrastructure is updated according to climate forecasts. What also emerged is that the process of infrastructure upgrade is an ongoing process since climate change projections usually change. Scanning this study's research findings it is evident that the eThekweni Municipality has played a major role in maintaining the infrastructure in the Point Waterfront area.

The current storm water drainage system is said to be capable of handling as much as 15% increase of rainfall in the area. Roads have been designed to cater for the climate conditions of the sea side. However, under a 1:100 year's storm, the electric infrastructure could face problems because the cabling is underground. It has also been noted that Sea Level Rise (SLR) will not be much of a problem with the exception of extreme events like the one that occurred in 2007. It is anticipated the Point Waterfront is likely to adapt well to the average annual SLR and to normal tides. The piers are designed to protect the small crafts harbour from violent storm surge waves of 3-5 meters in height. Meanwhile, properties along the sea shore have been

deliberately situated further inland to leave space for the high watermark line. Designers have planned the small crafts harbour and the hotel set to be constructed, below the high watermark line with climate change in mind.

In terms of social adaptation, not much has changed in the everyday lives of the people living or working in the Point Waterfront area. A possible explanation is that extreme events have not occurred to force those likely to be affected to make significant changes. The eThekweni Municipality has been reaching out to the community with information on how to minimize the impacts climate change has in their everyday lives. The use of the mass media has proved useful in the above outreach area when it comes to reaching out to the community. With dedicated television channels, radio announcements, the Internet, wave height updates and other publications, one could conclude that such efforts are reasonable although they could still be improved upon.

Environmentally, the Point Waterfront designers have plans to make the area green through landscaping. Besides making the area look more visually appealing, this greenery will help in cooling the area, besides stabilizing the soil against erosion. There are also efforts towards working in conjunction with the eThekweni Municipality on the pilot project of green roofing. These joint efforts will help in making the Point Waterfront area more environmentally adaptable to climate change. The only problem foreseen with such projects is that property owners will be the ones to decide whether or not to embrace the vision. Another major obstacle is that it was difficult to draw conclusions on economic adaptation due to the fact that the project is not yet complete. What is evident is that, to protect their properties, property owners have sought the services of insurance companies. In addition, the DWMA has been collecting funds through levies and other forms of financial penalties towards the payment of individuals and companies involved in providing particular services when required. The services provided focus on maintaining the state of the Point Waterfront Development. If the same strategy could be used to raise funds for climate change adaptation, the Point Waterfront will not need much intervention from outsiders with regards to climate change adaptation measures.

The issue of funding also came up repeatedly in the research. The stakeholders expressed concern that the sourcing of funding for climate change remained a disturbing an issue. While there are national institutions responsible for providing funds for climate change adaptation, such bodies alone cannot cover the overall costs of adaptation to climate change. It is for that reason that the eThekweni Municipality has committed itself to raising funds both from internal as well as external funders. Since it is evident that sourcing funding is not an easy task, there are still no clear boundaries as to how much each stakeholder performs in terms of joint efforts towards coming up with funds for climate change. This research study has shown that stakeholder participation is a crucial component of climate change adaptation. In terms of participation, eThekweni Municipality is the main stakeholder going out in full force in this respect.

6.3 Recommendations

For the Point Waterfront to be successful in climate change adaptation measures, the following recommendations are provided to give guidance:

- The developing company must make greater efforts to mainstream the issue of climate change adaptation, in the same way it does when it comes to other matters relating to the development;
- There must be clear boundaries that state the responsibilities of each and every stakeholder with regards to climate change adaptation funding;
- Funds must be collected in the form of levies, taxes and financial penalties for climate change adaptation;

- Policies should be put in place to formalize adaptation among residents. An example would be instituting a policy requiring every property to have a green roof;
- High taxes should be imposed on people using private cars in the area, aimed at promoting alternate environmental-friendly substitutes such as the use of public transport or cycling. Such efforts would be geared towards both the reduction of carbon emissions and traffic in the Point Waterfront area;
- In terms of participation, all stakeholders need to make greater effort towards coming together regularly to update each other on upcoming events relating to climate change adaptation;
- Community representatives should ensure communication with the residents targets everybody. This could be done through communicating in different languages, including sign language for the deaf;
- Early warning systems must go as far as to notify residents through mobile phones in the form of sms-es; and
- The DWMA should pressurize property developers to ensure that climate change adaptation is accounted for in every design, be it policy or layouts.

6.4 Final Conclusion

This research set out to assess whether the Point Waterfront Development in Durban has adaptation measures in place to cater for climate change. After a review of other waterfront developments around the world facing the same problem, it became clear that the Point Waterfront is fortunate to be located where it is since climate change is

not likely to be as severe as elsewhere around the world. The current adaptation and planning measures in the Point Waterfront have been put in place according to climate change predictions. One could conclude therefore that should climate change occur as predicted, the Point Waterfront would be able to withstand the impact of events associated with such vagaries of the weather.

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Appendix A

Interview 1

Brett Beswetherick (Planning and Land Use Management Office, eThekweni Municipality)

Date: 18 December 2012

Time: 9:00- 9:30AM

- a) What are the likely impacts of global warming on the Point Waterfront area?
- b) Could you briefly comment on what causes Sea Level Rise (SLR) in the Point Waterfront area?
- c) We have seen storms in the past resulting in raised sea levels and damaging properties along the Natal coast. To what extent do you foresee such events occurring along the Natal coast in future?
- d) Should sea level rise occur, to what extent would this sudden event be a threat to the Point Waterfront area development?
- e) What measures would you recommend to prevent or minimize the impacts of SLR?
- f) Could you comment as to whether an early warning system is currently in place to alert people should the SLR phenomenon loom?
- g) As a planning department, how far have you gone with climate change adaptation in the Point Area?
- h) Looking around the world at other developments built in proximity to the sea, how would the Point Waterfront development be able to cope with predictable impacts of climate change?
- i) What funds have been allocated towards dealing with such disasters should they occur at the Point Waterfront area?

- j) In your opinion, to what extent is there a need for climate change adaptation?
- k) What climate change adaptation measures have been taken by the relevant stakeholders in the Point Waterfront development this far?
- l) To what extent would climate change adaptation measures have the capacity to succeed if put to the test?
- m) What planning policies exist to enforce climate change adaptation in the Point Waterfront area?
- n) As planners, to what extent do you think it is your responsibility as planners to devise climate change measures?

Interview 2

Dr. Deborah Roberts (Environmental Planning Department of eThekweni Municipality)

Date: 09 January 2013

Time: 09:00- 09:30 AM

- a) Would you comment as to what extent the Point Waterfront area has every reason to be prepared for climate change?
- b) In which ways would you say climate change will impact on the Point Waterfront development?
- c) To what extent are the people living in the Point Waterfront area informed about climate change?
- d) What efforts, if any, have been taken to inform the people of point about climate change and global warming?
- e) We have seen storms in the past raising to sea level and damaging properties along the Natal coast. In your opinion, would such events occur in future? And if so, would the Point Waterfront be at risk?

- f) Currently, what measures are in place to prevent or minimize the impacts of sea level rise along the Point Waterfront area?
- g) What early warning systems are in place to alert people when such a phenomenon like sea level rise is about to happen?
- h) What have you heard concerning the local community being consulted in the decision making process concerning the Point Waterfront Development?
- i) In your opinion, how would consulting with the local community in the decision-making process help advance sustainable development in the Point Waterfront area? In which ways would you recommend such consultation to take place?
- j) Does the community operating within the Point Waterfront area know clearly of the environmental impacts likely to arise from sustainable development? And if so, in what ways?
- k) Looking at other developments around the world which are built in the proximity of the sea, how would the Point Waterfront development be able to cope with likely impacts of climate change?
- l) To what extent would you say that the principles of sustainable development have been applied in this development?
- m) What can other waterfront developments in South Africa and the rest of the world learn from this development in terms of environment considerations associated with climate change?
- n) What funds do you know of, if any, have been allocated to dealing with disasters associated with climate change in the Point Waterfront Development?
- o) Ideally, who should be responsible for funding the adaptation to climate change project at the Point Waterfront area?
- p) In your view to what extent is there need for climate change adaptation?

- q) What climate change adaptation measures have been taken by the relevant stakeholders in the Point Waterfront Development?
- r) Do you think these measures have the capacity to perform when put to test by climate change? If so, how?
- s) To what extent has the community been made aware of the Point Area climate change adaptation measures?

Interview 3

Gino D'eramo (Laurusco Development Financial Director)

Date: 10 January 2013

Time: 15:00- 15:30 PM

- a) What knowledge on climate change would you consider crucial in relation to the Point Waterfront?
- b) How what you have mentioned impact on the development of the Point Waterfront area?
- c) As far as you know, what efforts have been made so far to inform the people of the Point Waterfront about climate change and global warming?
- d) What measures are currently in place to prevent or minimize the impacts of sea level rise in the Point Waterfront area?
- e) What early warning systems are in place to alert people when disturbing phenomena such as the sea level rise are about to happen in the Point Waterfront area?
- f) To what extent has the community been consulted in the decision making process on the adverse effects of climate change and global warming concerning the Point Waterfront area?

- g) How will this consulting the community in the decision-making process help towards sustainable development in the Point Waterfront area? And in what ways?
- h) To what extent would you say that the principles of sustainable development have been applied in this development? And if so, to what extent would the marine environment be impacted?
- i) In your view, is there a need for climate change adaptation in Point Waterfront area?
- j) What climate change adaptation measures have been taken by the relevant stakeholders in the development of Point Waterfront area?

Interview 4

Sean O'Donogne (Acting Manager: Climate Protection Branch)

Date: 14 January 2013

Time: 13:30-14:00 PM

Q.1. To what extent have you ever been involved in the Point Waterfront climate change adaptation measures planning?

Q.2. What measures, if any, has the eThekweni Municipality put in place to benefit the Point Waterfront area?

Q.3. Talking of 'greening' the Point Waterfront area, how much has the eThekweni Municipality done in promoting this program?

Q. 4. What policies do the Climate Protection Branch in favour of the application of the 'green roof project' in the Waterfront Point area?

Q.5. To what extent is it the eThekweni Municipality's duty to devise measures associated with climate change adaptation?

Interview 5

Dr. Andrew Mather (Project Executive, Engineering Department of EThekweni Municipality)

Date: 16 January 2013

Time: 14: 00-14-30 PM

- a) As a specialist in coastal management and sea level rise, what do you predict concerning the future situation in relation to climate change at the Point Waterfront?
- b) From an engineering perspective, to what extent can the infrastructure handle the predicted changes in relation to climate change at the Point Waterfront?
- c) In the past we have seen storms in the past causing sea level rise and damaging properties along the Natal coast, what is the likelihood of such events occurring in future?
- d) What measures are currently in place to prevent or minimize the impacts of sea level rise (SLR)?
- e) What kind of early warning systems in place to alert people when such phenomena are about to happen?
- f) How closely do you work with architects and planners in terms of determining standards in the designs at the Point Waterfront area?
- g) At what level would the marine environment be impacted by the development and its adaptation measures?
- h) Comparing with other developments worldwide which are built in the proximity of the sea, how is the Point Waterfront area development likely to cope with the impacts of climate change?
- i) What can other waterfront developments in South Africa and the rest of the world learn from Point Waterfront area development in terms of coping with climate change adaptation measures?
- j) What funds, if any, have been allocated towards dealing with such disasters in Point Waterfront area?
- k) What climate change adaptation measures have been taken by the relevant stakeholders in the Point Waterfront area development?

- l) To what extent do you think these measures have the capacity to perform when put to test by climate change?

Interview 6

Bongumusa Dlamini (Ward Councilor)

Date: 18 January 2013

Time: 11: 00- 11: 20AM

- a) Could you briefly talk on the knowledge you have about climate change likely to affect the Point Waterfront area?
- b) Please summarize the knowledge you have concerning global warming in general?
- c) What efforts, if any, have been made to inform the people of the Point Waterfront area about climate change and global warming?
- d) How informed are the people living in point about climate change?
- e) How do you think the above will impact in the Point Waterfront area development?
- f) Has the community been consulted in the decision making process concerning??
- g) How clearly is the community aware of the adverse environmental impacts that could in future affect the Point Waterfront area development?
- h) Do you know of any community forums through which the adverse environmental impacts are discussed?
- i) In your opinion, to what extent is there a need for climate change adaptation?
- j) What climate change adaptation measures have already been taken by the relevant stakeholders in the Point Waterfront area development?

- k) To what extent has the community been made aware of these adopted measures?
- l) Do the measures currently in place have the capacity to help withstand the vagaries of climate change?