CITY OF CAPE TOWN
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City of Cape Town

Coastal Management Line: method and process

2014

City of Cape Town Coastal Management Line: method and process

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ACRONYMS

BioNet:	Biodiversity Network
City:	City of Cape Town Metropolitan Municipality, established in terms of the Local Government: Municipal Structures Act, 1998 read with the Province of the Western Cape: Provincial Gazette 558 dated 22 September 2000
City:	Cape Town
CML:	Coastal Management Line
CPZ:	Coastal Protection Zone
CT:SDF:	City of Cape Town Spatial Development Framework
DEA:	Department of Environmental Affairs
DEA&DP:	Department of Environmental Affairs and Development Planning
EGS:	Ecosystems Goods and Services

GIS:	Geographic Information System
HWM:	High-Water Mark
ICMA:	Integrated Coastal Management Act
ICM Bill:	Integrated Coastal Management Bill
I & APs:	Interested and Affected Parties
LLD:	Land Levelling Datum
MCMP:	Municipal Coastal Management Programme
ODM:	Overberg District Municipality
POS:	Public Open Space
PPP:	Public Participation Process
PSE:	Participatory Stakeholder Engagement
SDE:	Scenic Drive Envelope
SDNMP:	Scenic Drives Network Management Plan
SEMA:	Specific Environmental Management Act
SLRRA:	Sea-Level Rise Risk Assessment
TMNP:	Table Mountain National Park
TEV:	Total Economic Value

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1. EXECUTIVE SUMMARY

The City of Cape Town's (the City) coastline is a complex space - it is a nexus of social, economic, ecological and legislative systems managed by three different tiers of government often with overlapping roles and responsibilities. Although the coastline is one of Cape Town's most important socio-economic and environmental assets, paradoxically, the coastline is also a source of risk to the City. This coastal risk is currently being compounded by the absence of a city-wide strategic decision support framework required to promote informed and risk averse coastal planning decisions. Historically decisions relating to the coast have by enlarge been ad hoc, piecemeal and reactive. Climate change is expected to heighten the challenge of risk governance at the municipal level into the future. In responding to these challenges, the City commenced with the delineation of a Coastal Management Line (CML) in 2007. The primary intent of the City's CML is to guide and shape municipal decision making that is consistent, strategic, promotes sustainable coastal development and ultimately retains the coast as an asset in the interests of the broader public.

It is well known that CMLs have a range of significant socio-economic implications. As risk is essentially a human value, the City considered it non-negotiable to apply a multidisciplinary and iterative approach that considered a range of socio-economic and biophysical elements in defining its CML. Through broad scale engagement and the required deliberation with interested and affected parties since 2007, the City has determined a CML that is based on scientific, practitioner and community based knowledge and as such is grounded within the realities of a developing city scale context. Most importantly this approach has produced a CML that achieves a balance between socio-economic imperatives whilst simultaneously installing risk averse principles in City planning.

A critical component in developing a CML is the recognition that there is neither legislation nor planning mechanisms in South Africa designed to resolve and to manage existing infrastructure at risk. Further to this, CMLs are not designed nor equipped to manage risk retrospectively. The City is therefore in the process of developing a range of supportive planning and land use regulatory mechanisms, notable the overlay zone and the by-law, designed to both give regulatory support to the City's CML as well as address the much neglected matter of existing property and infrastructure at risk to coastal hazards.

2. INTRODUCTION

The City commenced work on delineating its CML in 2007. The City realised the importance of undertaking proactive measures with the intent to address a multitude of growing pressures along the City's coastline[1]. The determination of a CML that considered the connections

[1] The coastline in terms of this report is defined as the dynamic interface between land and sea masses where this dyanmic space contributes both directly and indirectly to the livelihoods of the residents of Cape Town.

between socio-economic and environmental systems was identified as the most appropriate and effective approach towards managing these pressures within a complex and dynamic space. This approach was used with the intent of achieving five primary objectives, namely to promote access to the coast, to promote increased degrees of Integrated Coastal Management (ICM) within the City, to reduce risk to the City, to ensure that the socio-economic opportunities the coast currently provides are retained and enhanced into the future in perpetuity and to ensure the conservation of remaining functional coastal ecosystems.

The City's Spatial Development Framework (CT:SDF) was approved on the 8th of May 2012 under two different sets of legislation. It was approved as a component of the City's Integrated Development Plan in terms of the Municipal Systems Act (Act No 32 of 2000, section 34) as well as the Land Use Planning Ordinance (No. 15 of 1985, section 4(6)). The CT:SDF, together with the Provincial Spatial Development Framework forms the spatial planning document applicable to the municipal area of the City. The CT:SDF defines and spatially demarcates the City's Coastal Urban Edge. This report therefore represents the City's formal submission to the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) to formalise the City's Coastal Urban Edge as the draft CML in terms of the Integrated Coastal Management Act (ICMA) (Act 24 of 2008). As the City views the Coastal Urban Edge and draft CML as one and the same, for purposes of clarity this line will be referred to throughout as the draft CML. In addition to this numerous references are made to the Coastal Protection Zone (CPZ) and Coastal Protection Zone by-law in the various annexures. The CPZ in the annexures refers to the space between the draft CML and High-Water Mark (HWM). The City acknowledges that this is different to the definition and intention given to the CPZ in the ICMA. In light of this, and as per the City's Integrated Coastal Management By-law, will rename the space between the HWM and the draft CML as the "Coastal Environment" to avoid confusion. The City will in turn define a new CPZ in accordance with the requirements of ICMA.

2.1 Background and context

Cape Town's coastline is approximately 307km in length, making it the largest coastal metropolis in South Africa. The coastline of Cape Town extends from Silwerstroomstrand (18˚20'34.959"E and 33˚34'14.994"S) on the west coast to just south of Kogelbaai (18˚50'44.905"E and 34˚16'10.554"S) on the east coast. Cape Town is renowned for its beaches and coastal beauty which are arguably its greatest socio-economic and environmental asset, providing a support base, both directly and indirectly, to a coastal population with vast socio-economic inequalities. Value from the coast is derived from a multiplicity of ecosystems goods and services (EGS) as a consequence of the coast's unique biophysical attributes. Ecosystems goods and services may be broadly categorised as cultural, regulatory, supportive and provisional. Reflecting the value of the coastline, and based on cultural services alone, it is estimated that the city's beaches can be valued at approximately R77 million per annum. This figure reflects only a fraction of the Total Economic Value (TEV) as it is based purely on the cultural value of beaches alone in Cape Town. It does not reflect the regulatory, provisional and support value (de Wit *et al*, 2009).

Paradoxically, however, the coastline also contributes to the City's risk profile. The coastline of the city is a harsh and highly dynamic environment, where the biophysical attributes of the coastline are in a constant state of flux. Some of this change is cyclical and predictable, taking

place over relatively short (seasonal) temporal scales, whilst other change is unseasonable and unpredictable[2]. Reflecting seasonal dynamics at a broad scale is the accretion of beaches within False Bay (on the eastern side of the city) in winter and the erosion of these beaches in summer. The opposite pattern occurs on the west coast where beaches generally erode in winter and accrete in summer. These seasonal cycles in coastal dynamics are primarily driven by two major atmospheric systems. These include the periodic mid-latitude cyclones (storms) that occur during the winter months which typically result in higher seas, and the south Atlantic high pressure system that results in south easterlies during the summer months, and subsequently calmer seas (Tadross *et al,* 2012). Examples of less predictable coastal dynamics include migrating estuary mouths, localised beach regression and accretion events as well as storm surges. These unpredictable examples often result in abrupt changes in coastal geomorphology. Both of these abrupt changes, and to a lesser extent, the predicted seasonal dynamics, impact on coastal infrastructure and ultimately the City's ability to maintain effective service delivery.

The dynamic and at times unpredictable nature of the coastline is a source of risk to the City. Exposure to this risk is set to be compounded considering the warming of the earth's atmosphere. Global warming is expected to have a significant impact on coastal dynamics, where fluctuations in environmental systems are set to become more pronounced. This is a key concern to the City considering the value of the coastline from an EGS perspective, but also due to the amount of critical infrastructure located along the coastline. The City's Sea-Level Rise Risk Assessment (SLRRA) identified an area totalling 25km² that is highly vulnerable to the expected impacts of sea-level rise, storm surges and subsequent coastal erosion (Cartwright, 2008). Within this area, it is estimated that there is approximately R5 billion[3] worth of City infrastructure that is at risk (Cartwright, 2008).

Considering globalisation, market driven economies and the priority of promoting economic growth through development[4], it is expected that growth in the city (as in the case of many world cities) is set to increase significantly into the future (Figure 1) (CCT, 2012). With the perception that coastal frontage property equates to economic wealth and gain, much of this growth is expected to have an impact on the coast.

[2] Less predictable change may still be cyclic, but just over longer and less defined periods of time. Such change may also be a result of climate variation as opposed to human induced climate change.
[3] This value reflects the cumulative value of infrastructure at risk at all points along the coastline over the next 25 years. Considering that the coastline of the city is not a homogenous environment, this risk zone will not be impacted upon uniformly.
[4] The approach of using development as a means to address poverty and unemployment is formally represented by the Accelerated and Shared Growth Initiative of South Africa. This initiative has set a target of achieving an average growth rate of 6% in GDP per annum. Added to this, 5 of the 8 Spatial Development Initiatives identified by the South African Government occur within coastal regions (South African Info, 2008).

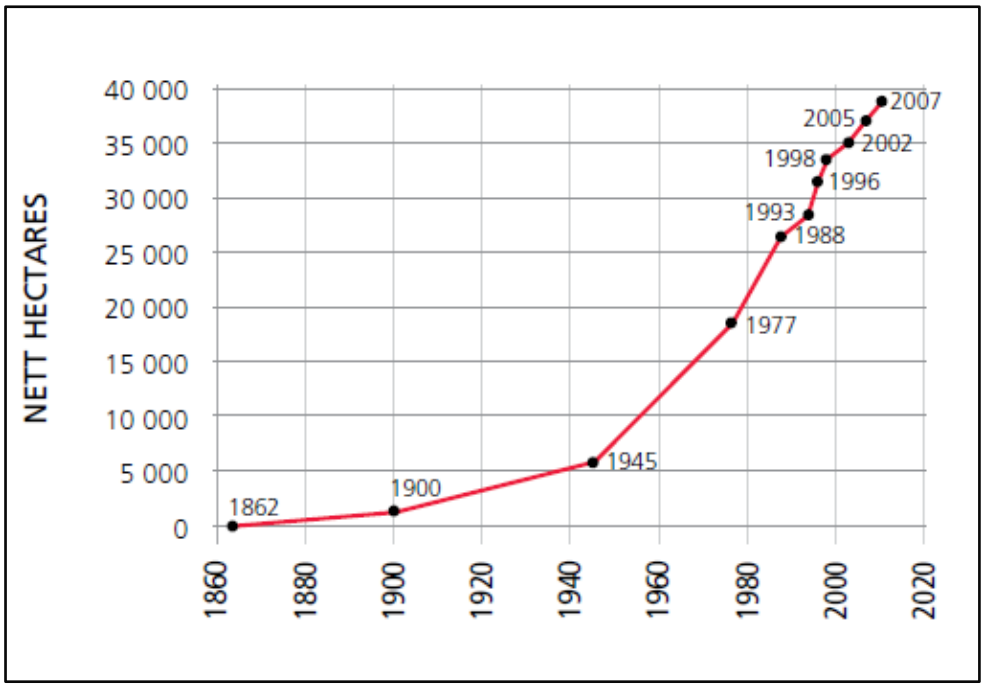

Figure 1: City of Cape Town growth from 1860 to 2007

(Source: CCT, 2012).

Considering these factors of expected growth, increased pressure, value of the coast, coastal dynamic processes, the presence of critical infrastructure, the expected impacts of climate change, and the potential the coast has of becoming a source of risk to the City, it is imperative that appropriate regulatory mechanisms are developed to facilitate more effective governance and management of the coast. This will be critical towards ensuring the sustainability of the coast, ensuring the socio-economic potential of the coast is optimised and ultimately contributes to the prosperity of the city.

2.2 Report structure

This report details the City's method and process in delineating its draft CML. The report begins with determining objectives (Section 2.3) followed by a description of the City's legal mandate with respect to defining a CML in terms of the ICMA (Section 2.4). Section 3 begins with identifying and describing general principles that the City considers essential in establishing CMLs. Following from this general overview, the report details a range of specific informants, based on a local level analysis, that were used to define the draft CML for the city's entire coastline (Section 4). Section 5 details the City's methodology of delineating estuaries for inclusion within the City's CML.

This report also details the process the City has undertaken in developing its draft CML. This primarily focuses on the stakeholder engagement process, both informally (Section 6.1) and formally (Section 6.2). Section 7 draws a comparison between the City's approach and that used in Overberg District Municipality (ODM).

Section 8 describes the 'bigger picture', providing information on the various supportive coastal regulatory mechanisms the City intends to develop in order to achieve the intent of the City's draft CML. Section 9 outlines the implications to the City of not having a CML in place. Section 10 concludes the report through summarising the method, process and proposed supportive coastal regulatory mechanisms outlined in Section 9. References, acknowledgment and annexures are provided in Sections 11, 12 and 13 respectively.

2.3 Objectives of the report

This report represents the City's submission to DEA&DP for the formalisation of the City's draft CML in terms of the requirements of ICMA. The objectives of this report are therefore to:

1) Report on internal processes and consultations as well as the extensive Public Participation Process (PPP) undertaken in the formalisation of the City's draft CML as the coastal urban edge in terms of the CT:SDF;
2) Provide a formal report to DEA&DP on the City's draft CML delineation methodology;
3) Provide a comparison between the City's methodology, the Western Cape Methodology and the Overberg District Municipality's (ODM) Methodology,
4) Report on the City's progress and intentions with respect to the following supportive regulatory mechanisms to the CML:
    a. Municipal Coastal Management Programme
    b. Integrated Coastal Management Policy
    c. Coastal By-law
    d. Coastal Protection Overlay Zones
5) Highlight the implications and risks to the City of not having a CML in place.

2.4 Meeting the requirements of the Integrated Coastal Management Act

The South African government in May 1997 began an extensive and integrated process of public participation research analysis to develop the White Paper for Sustainable Coastal Development in South Africa. The policy, in essence, "…aims to achieve sustainable development through a dedicated and integrated coastal management approach, in partnership with all South Africans" (DEAT, 2000: Foreword). Within this, policy provision was made for a Plan of Action which outlines in detail how the aims and objectives of the White Paper are to be met (DEAT, 2006). Resulting from this, and as a component of the *Plan of Action,* an Integrated Coastal Management Bill (ICM Bill) was made available for public comment in December 2006. In September 2008 it was accepted by the National Council of Provinces and on the 1st of December 2009, with the exception of certain sections, it became legally enforceable in South Africa. The ICMA is therefore South Africa's first legal instrument

designated for promoting integrated management of the coastal zone and as such a tool towards assisting the White Paper in achieving its goals.

2.4.1 Section 25 of the ICMA: establishment of CMLs

The establishment of a CML for coastal municipalities is a legal requirement of the ICMA. In terms of Section 25 of the ICMA, CMLs must be established:

I. "to protect coastal public property, private property and private safety;
II. to protect the coastal protection zone;
III. to preserve the aesthetic values of the coastal zone;
IV. for any other reason consistent with the objectives of this Act; and
V. prohibit or restrict the building, erection, alteration or extension of structures that are wholly or partially seaward of that CML" (ICMA, 2008: 42).

In general terms, a CML is used as a planning mechanism to guide decision makers to more effectively regulate coastal development and to avoid risk from coastal hazards into the future. The focus of this regulation centres on the need to minimize the impact of development on sensitive coastal ecosystems, to retain and promote access to the coast, to prevent exposure of coastal property to risk from coastal processes, such as storm surges, coastal erosion, beach regression, migrating dune systems, and to retain the aesthetics and sense of place of the coastal space.

The City has defined its draft CML in terms of the requirements of the ICMA. Through the application of the CML, the City intends to manage the impact of development and activities on the coast to retain and improve the value and opportunities the coast provides. In addition to this the draft CML will be used to ensure the coast remains accessible to all. To achieve these broader imperatives, CMLs require supportive regulatory mechanisms which will in turn require an integrative and multidisciplinary approach. The use of supportive regulatory mechanisms is also a requirement of the ICMA which states that local municipalities must incorporate CMLs into municipal coastal planning schemes. In recognition of the value of CMLs from a spatial planning perspective the City's draft CML has been used to define the City's Coastal Urban Edge.

3. METHOD: GENERAL PRINCIPLES FOR THE DELINEATION OF CAPE TOWN'S CML

3.1 Introduction: socio-Institutional and biophysical response towards managing coastal risk

Although coastal dynamics and climate change pose a significant threat to the City, it is not the change of environmental systems in itself that will increases the City's risk profile. Rather it is the interaction of dynamic coastal processes, climate change pressures, the location of infrastructure along the coast and most critically the planning decisions that influence the

location and nature of this infrastructure that determines the City's risk profile (Figure 2). With an increasingly transformed coastline, the presence of infrastructure within this dynamic space and the predicted impacts of climate change, there is a real threat that the opportunities the coastal environment currently provides will not only decrease into the future, but through continued inappropriate decision making and management interventions, the coast in itself will become an economic burden to the City. As it is now well known that the coast is a dynamic and unpredictable space, and that risk associated with the coast is expected to increase as a consequence of climate change, the City is developing planning mechanisms to more effectively guide and shape decisions to avoid the growth of risk into the future. The CML is one such mechanism.

Figure 2: Hout Bay, Cape Town

A sediment by-pass system trying to re-establish itself and connect to Sandy Bay. It is not the migration of the dune system that is the problem, but rather the inappropriate decisions taken to allow infrastructure to be built in a high risk space *(Image courtesy of the Aerial Perspective: www.aerialphoto.co.za).*

The predicted impacts of global warming and the associated intensification of risk requires that there is a fundamental shift in the manner in which decisions are made in relation to the coast. Decision making needs to adopt a more risk averse approach, where the complex relations between coastal processes, infrastructure and risk management are taken into account. If the status quo remains where there is a lack of a strategic city-wide decision support framework, decisions relating to coastal infrastructure and development will remain limited to an *ad hoc* and reactive and basis and risk to the city from the coast will increase.

There are multiple approaches, both globally and in South Africa, that have been used to manage the coast as a dynamic and risk space. According to Cartwright (2009) these approaches can be divided into six broad approaches:

1. 'holding the line', where coastal retreat from erosion is prevented through the installation of hard engineering interventions such as sea walls;
2. a phased retreat approach, whereby coastal infrastructure is re-aligned as a consequence of advancing coastal erosion;
3. socio-institutional learning, such as the establishment of CMLs to regulate development and activities along the coast;
4. biological responses (ecosystems-based management);
5. on-going decision making and iterative progress, and
6. 'do nothing and wait and see' approach where no intervention is undertaken to alter the status quo.

The City has developed a mechanism that has merged socio-institutional and biological responses, thus combining the merits of both, into a single strategy. Whilst socio-institutional responses include a range of approaches[5], this report is primarily focussed on the development of a CML for the City. Key to the success of any CML is the understanding of the unique local context within which the coast exists and to which the CML will be applied. As CMLs have significant socio-economic implications, CML methodologies must draw in and reflect localised social, economic and environmental interests. The application of CMLs to manage risk is not only the most cost effective approach from a cost benefit perspective (Figure 3), but it acts on the most critical issue: socio-institutional transformation through more appropriate and risk averse decision making. This approach will guide and shape decisions that are made in the sensitive coastal space, and it will ensure that the range of benefits and opportunities the coast provides will be retained and enhanced into the future. Thus, this socio-institutional and biological approach will ensure that when decisions are made, these decisions will be made in the interest of the broader community.

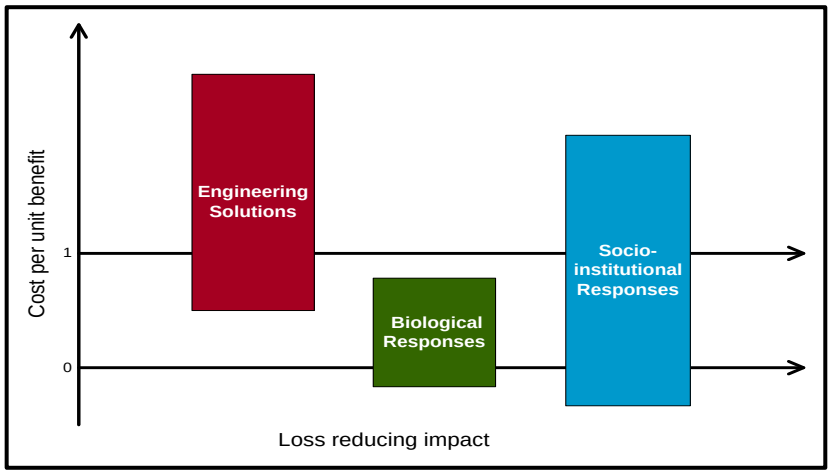

Figure 3: Cost benefit of a range of coastal protection interventions

A stylised representation of the range of cost benefit per unit for engineering, biological and socio-institutional responses (Source: Cartwright, 2009).

[5] Other socio-institutional responses include vulnerability mapping, application of coastal legislation, research and monitoring, early warning systems, disaster management systems etc. (Cartwright, 2008). Whilst the City has these in place, the intention of this report is to focus on the City's CML.

3.2 14 Key principles in developing a CML

There are 12 key principles that are critical towards achieving an effective and pragmatic CML. These 12 key principles are identified as (taken from Colenbrander *et al,* in press*)*:

1. The coast must be acknowledged as a complex and connected space, where social-ecological systems are inherently linked;
2. The social, economic and environmental implications of CMLs require that CML methodologies shift away from a myopic focus on modelling biophysical risk to a more inclusive multi-disciplinary that draws in socio-economic and broader environmental dimensions;
3. Risk from coastal modelling must be treated as indicative and not absolute;
4. Adopting a multi-disciplinary approach is key to aiding municipal planners to identify and navigate the tensions that arise out of the process of defining CMLs at a localised scale;
5. The inclusion of localised socio-economic and environmental dimensions is central to the effectiveness of CMLs, ICM and ultimately sustainable coastal development;
6. As local contexts require local solutions, CML methodologies must be developed and grounded within local realities;
7. In the case where CMLs are defined internally within municipalities, municipal authorities must be capacitated. The capacitation of municipalities must be seen as the preferred alternative as with capacitation comes both institutional memory and local knowledge of the coast. It is this 'grounded' knowledge that is likely to yield CMLs that are connected to the social, economic and environmental nuances of the coast and which is critical in developing an effective and pragmatic CML;
8. CMLs must be developed in a way that promotes their integration into locally developed planning and building regulation schemes;
9. Practicality and simplicity: the coastal zone is a complex space. The effectiveness of a CML is largely dependent upon its practical application;
10. Risk from coastal hazards is a shared problem. The development of CMLs to manage this risk must be founded on a collectively determined resolution between authorities and the public: the process must determine the outcome;
11. The determination of CMLs must be an iterative process informed by scientific, practitioner and community based knowledge;
12. The process of defining CMLs requires negotiation and dialogue over meaningful periods of time with I & APs;

These principles have been applied in the determination of the City's CML. Based on these principles, the CML forms the foundation from which to stimulate and promote the triple bottom line: economic development and access to the coast, the improvement of livelihoods of coastal communities through promoting economic and social opportunities whilst simultaneously reducing risk and finally the preservation of coastal ecosystems and associated goods and services.

The coast of South Africa is remarkably variable, in both socio-economic and biophysical attributes. Even within the city, there are vast differences in the socio-economic and biophysical attributes of the False Bay coastline compared to that of the West coast. These

localised differences necessitate that local solutions are developed for local conditions. It is these unique conditions that must determine the informants used in developing the methodology for determining CMLs. In the case of Cape Town, it is the combination of a highly urbanised coastline interspersed by fragmented swathes of undeveloped land together with vastly differing socio-economic conditions along the coast that has largely influenced the City's CML methodology.

3.3 A complex urban and peri-urban coastal environment: a practical approach

Cape Town is a metropolis. Much of the coastline has already been developed extensively, in many places up to the HWM. In some places, such as Sea Point and the Foreshore, reclamation has taken place. The coastline has therefore been completely altered in certain areas. However, interspersed between these developed segments of the coastline are stretches of undeveloped land retaining functional coastal ecosystems. It is these vastly differing segments of coastline and associated socio-economic attributes that has necessitated a practical approach towards defining a CML that works for the City.

The placement of CMLs has real implications for property owners, especially where property may fall within (seaward of) CMLs. The implications are varied, but the most significant being the potential devaluation of the property as a consequence of CMLs defining risk zones. The recent experience in the Overberg District Municipality is a case in point where the process of defining the CML was met with much negativity and in some cases the position of the CML was contested (DEA&DP, 2011). Considering that different models yield different results based on different input parameters and the subsequent uncertainty surrounding the prediction of risk from storm surges, coastal erosion and sea-level-rise, challenging the position of the CML in relation to cadastral boundaries was fully justified.

Due to the presence of private properties with existing development rights in close proximity to the high-water mark, and the potential legal challenges that may arise through including properties within CMLs, the City has deliberately excluded properties with development rights from the City's draft CML. This approach applies to properties with development rights that are potentially at risk from storm surges and coastal processes. Through adopting this approach, and as a general, rule of thumb, the City's draft CML follows the most seaward cadastral boundary of properties with existing development rights in developed areas. The opposite is true for less developed sections of the coast (land predominantly owned by the City) where coastal ecosystems are still intact and as such the City's CML is extended further inland based on additional key informants. A detailed description of these informants is provided in Section 4: Key Informants in the Delineation of Cape Town's CML.

This approach has resulted in the following outcomes:

- A practical approach that seeks to achieve uncomplicated outcomes;
- This approach has enabled the City to focus on the priority areas of less developed coastal stretches;

- In these less developed areas the City is in the position to prevent inappropriate decision making (Figure 2, 5, 11 and 18 refers) in terms of coastal development recurring and increasing into the future;
- As a consequence, the City's social risk profile is reduced;
- Reduce the unnecessary burden of environmental legislation on already developed footprints;
- Develop appropriate spatial planning mechanisms and equip the City to address and manage existing infrastructure at risk to coastal processes and storm surges, and These attributes have in turn resulted in majority (97%) public support and buy-in to the City's CML.

This approach has been undertaken to get the 'basics' right first: prevention of further inappropriately located development along less developed stretches of the City's coast. As a consequence of this approach, and the deliberate exclusion of private property with existing rights from the draft CML, there is a substantial amount of property and infrastructure that is located landward of the draft CML, but is still at risk from storm surges and coastal erosion (Figure 4).

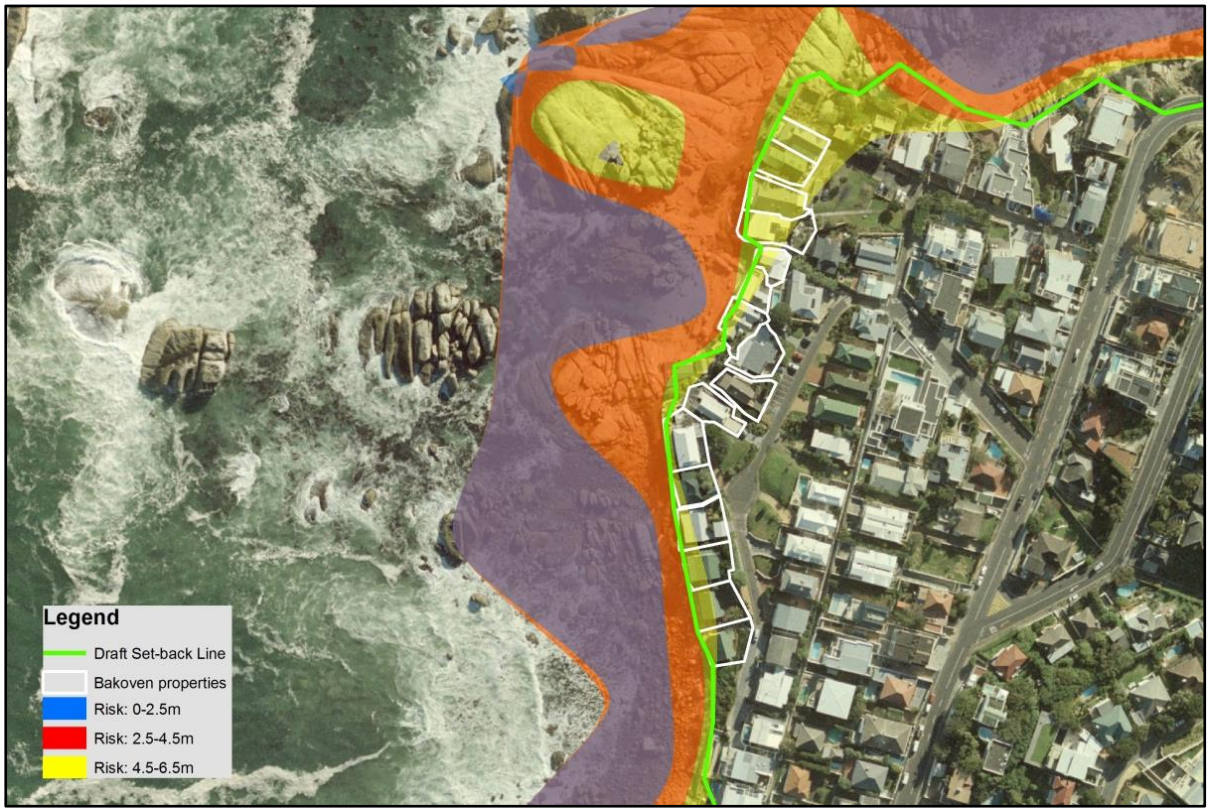

Figure 4: Private property in Bakoven at risk from storm surges

Properties such as these are on the landward side of the City's draft CML but are still at risk from storm surges. Many of these properties can no longer claim insurance for damage caused by storm surges. Addressing this requires additional supportive regulatory frameworks (Section 8).

Addressing existing property at risk is a complex matter as it draws in legalities relating to property rights and impacts on property values. This cannot be adequately addressed through the application of another CML. In addition to this CMLs are not designed nor equipped to address existing infrastructure at risk. Due to the ineffectiveness of CMLs in retrospectively responding to risk, the management of risk in these circumstances requires additional supportive regulatory mechanisms and is best dealt with through a policy approach. Although not directly linked to the City's method of defining a CML, this report provides further detail on these regulatory mechanisms and the City's Integrated Coastal Management Policy (Annexure M) to give a broader context to the method and process in defining CMLs and how the City intends to manage existing infrastructure at risk into the future. This detail is covered in Section 8: Process Forward: Supportive Planning and Regulatory Mechanisms for the City's CML.

3.4 Table Mountain National Park

Cape Town's coastline is approximately 307km long. Of this, 67km (22%) of the length of this coastline falls within Table Mountain National Park. This land is administered by the South African National Parks. In addition to national park land, there are other parcels of land that are located along the coast within the City's area of jurisdiction, but which is not administered by the City. Examples of these parcels of land include land surrounding the Koeberg Nuclear Station (Eskom), crown land and ports (National Ports Authority). As the City does not have any jurisdiction over this land, the City has not demarcated a CML within these parcels of land. The City's existing draft CML is therefore not contiguous for the entire length of coastline but is punctuated by gaps reflecting these various parcels of land.

4. METHOD: KEY INFORMANTS TO THE DELINEATION OF CAPE TOWN'S CML

The intention of a CML is to guide planning decisions to promote sustainable coastal development whilst simultaneously retaining and enhancing the ecosystems services provided by our coastal resources. To achieve this, it is important that the key coastal issues themselves are used to inform the process of defining a CML. The effectiveness of a CML is therefore largely dependent on our ability to grasp coastal issues at the local level and which span a variety of disciplines. Adopting a trans-disciplinary approach assists in the development of a more holistic understanding of the coast and the nature of connections between the various informants. This approach is paramount in efforts towards achieving the City's goals of retaining the coast as an asset and increasing the opportunities the coast provides into the future. Based on this trans-disciplinary approach, the following key socio-economic and environmental informants have been used in delineating the City's CML (Section 4.1. to 4.5 details how these informants were incorporated into the City's CML):

- The socio-economic imperative of promoting access to the coast and redressing the inequalities of South Africa's past of exclusion;
- Risk from sea-level rise, storm surges and coastal erosion;
- Risk from coastal dynamic processes;

- The need to retain the sense of place, coastal aesthetics and heritage value of the coast;
- Protection of coastal systems and processes, and
- The importance of retaining biodiversity as a central pillar towards addressing these challenges.

Whilst these informants have been listed separately, there are strong connections between them. For example, by protecting coastal biodiversity corridors, not only are coastal aesthetics and sense of place retained, but the buffer potential that these systems provide to storm surges is retained. This in turn reduces the potential for transferring risk to coastal communities. The recreational and amenity value of the coast as an important social asset is also retained. The recognition of the coast as a coupled socio-economic and environmental system is critical not only in the process of defining a CML but is central to the principals of ICM.

4.1 CML informant one: promoting access to the coast

The coast of Cape Town is an important socio-economic asset. Considering the vast inequalities of coastal communities along the City's coastline, and South Arica's apartheid past, it is imperative that previously disadvantaged communities are afforded the same opportunity to gain access to the coast to improve their livelihoods as did the ruling white minority in the past. The presence of communities along the Cape Flats coastline is an example of 'Environmental Apartheid': different races were forced to live separately in terms of the Group Areas Act. In addition to this, certain races were forced to relocate to less desirable areas that are subject to harsh environmental conditions which include persistent and strong winds, wind-blown sand, salt spray etc.

The Cape Flats is no exception. The desire to improve the livelihoods of previously disadvantaged communities through tapping into coastal resources of the Cape Flats coastline must therefore be balanced with avoiding risk arising from the harsh environmental and coastal conditions. Finding this balance between promoting access to the coast whilst remaining risk averse is critical and requires in-depth research. In the event of inappropriate coastal planning, the City unintentionally generates risk. Paradoxically, this risk is then transferred back to the local community to which such developments were intended to benefit.

Figure 5: Macassar Pavilion

Macassar Pavilion was developed to promote access to the coast through enhancing the recreational and amenity value of the coast. However, due to its location in a harsh environmental space exposed to strong south easters and wind-blown sand, the Pavilion is now derelict and subject to anti-social behaviour of prostitution, crime and drug abuse. The risk associated with these social ills has been transferred to the local communities to which this Pavilion was originally supposed to benefit.

Realising the impacts on spatial form of City development as a consequence of CMLs, the process of designating coastal access was drawn into the principles contained within the CML methodology. The City has identified two tiers of access according to the scale at which access is promoted along the coast. The first scale, or macro scale, is at the level of promoting broad scale socio-economic benefits through connecting communities to the coast by means of nodal growth. The second tier or micro scale is at the level of promoting safe and environmentally sensitive access to the beach via designated access paths, i.e. shoreline or coastal access. The City's CML has been established with the intention to promote and enhance both tiers of access.

4.1.1 Macro scale access: nodal growth points

The intent to address the inequalities of the past through connecting communities to the coast via development, and ensuring that this development takes place in nodal rather than strip form is reflected in the CT:SDF. The CT:SDF has identified a number of nodal growth points along the City's coastline. Current priorities are Silwerstroomstrand on the west coast as well as Strandfontein, Mnandi and Monwabisi in the Cape Flats region of the False Bay coastline. Along the False Bay coastline, where the need to promote access to the coast is more intense, nodal growth areas were identified in a study entitled *Rapid Planning Review of Potential*

Future Development Areas along False Bay Coastline undertaken in 2009 (Annexure A). The study area focussed on the stretch of coast between Strandfontein and Monwabisi and investigated future urban development opportunities for the Cape Flats coastline. The study included the following:

- The development of a concise synthesis of strategy and policy imperatives that inform development along the coast;
- The identification of key development challenges and opportunities experienced within the study area;
- The identification of zones for development opportunity along the relevant section of the coastline;
- The identification of a set of guiding principles that should inform development proposals along this stretch of coastline, and
- A detailed analysis of the local biophysical informants that may restrict development at the identified zones of opportunity (CCT, 2009).

The outcomes of the study identified four key coastal nodal development opportunities at the sub-regional scale. These four nodal points were identified as Monwabisi, Mnandi, Blue Waters and the Strandfontein Pavilion (Figure 6).

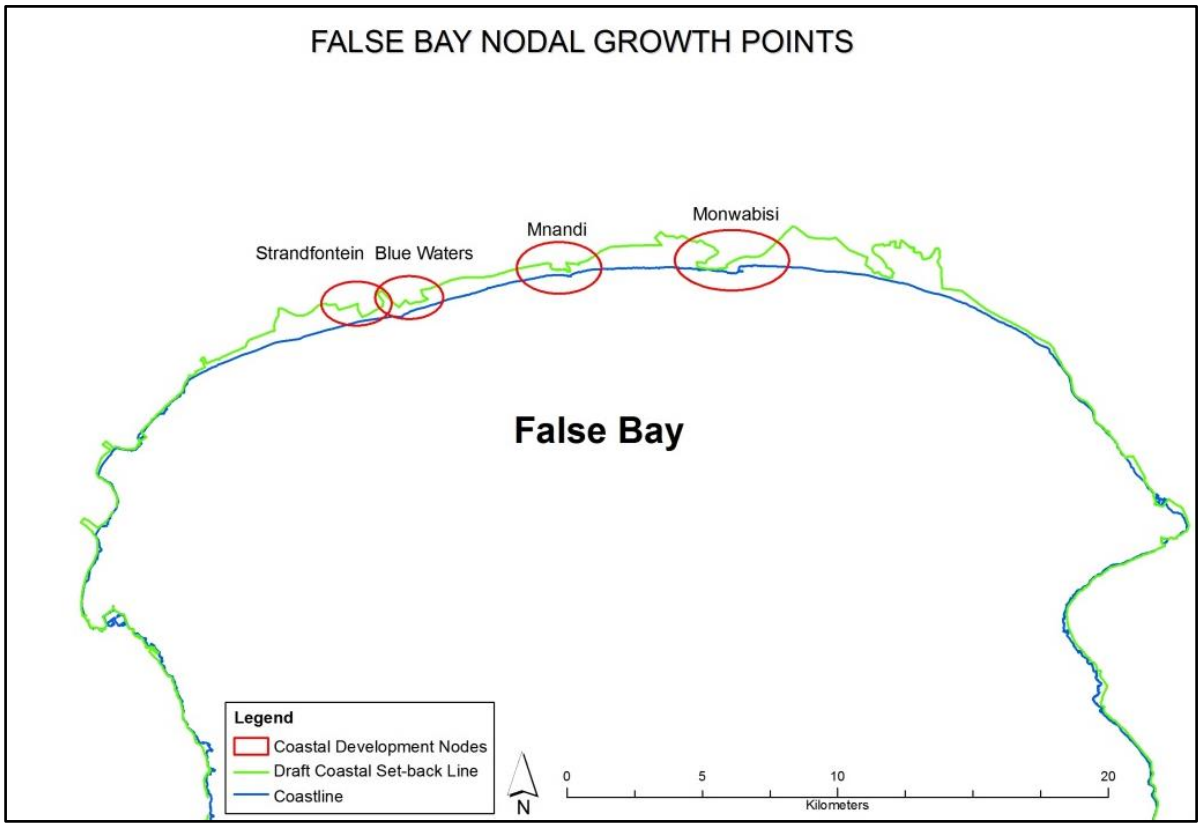

Figure 6: Nodal Growth Points

The four nodal growth points identified for the False Bay coastline

Provision was therefore made for these growth points in defining the City's CML. Although these nodal growth points have been defined in terms of the need to promote access to the coast, the specific footprint of these nodal growth points were further refined based on key informants of biodiversity corridors, dynamic coastal processes, risk from sea-level rise and storm surges etc (Figure 7). When funding is available and development does take place with these nodal growth points, more detailed studies as well as environmental authorisations will be required to limit the impact to the broader environment and to ensure that social risk to coastal hazards is reduced.

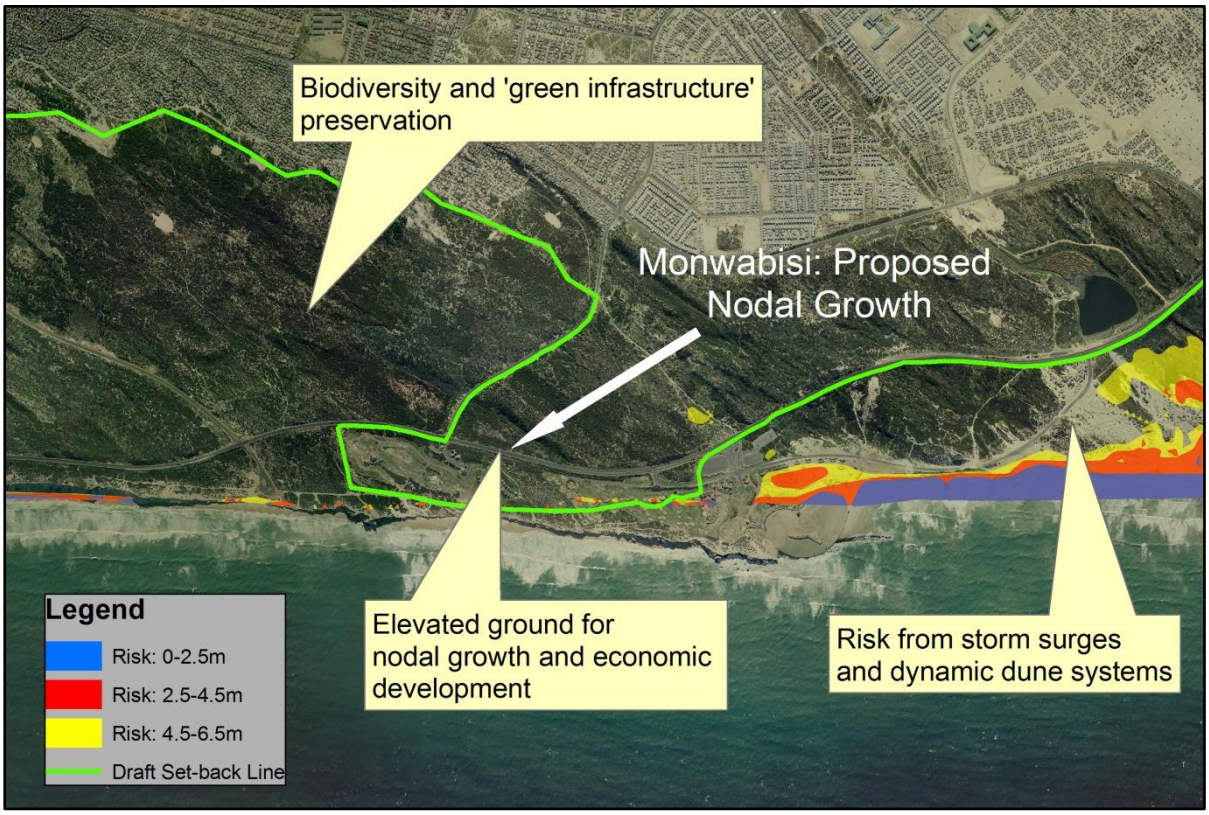

Figure 7: Monwabisi Coastal Resort

The City has defined a CML that both promotes access to the coast through nodal growth whilst simultaneously ***retaining 'green infrastructure'*** *and demarcating areas to be avoided due to sea-level rise, storm surges and coastal dynamic processes***.**

4.1.2 Micro scale access: access to the beach

As important as it is to unlock the economic potential of the coast through nodal growth points, it is similarly important to retain access to the coast on a smaller scale through designated coastal access paths. Access to the beach may become compromised due to a number of factors. The greatest threat to equitable access to the beach is strip development and subsequent privatisation of the coast (Figure 8).

Figure 8: Privatisation of the coast, Salt Rock, KZN

Access to the beach by the general public along this stretch of coast in KZN is severely compromised.

The only remaining access points along this stretch of coast in KZN are isolated servitudes, where there is little or no space allowed for supporting amenities such as car parks, showers, ablutions etc. (Figure 9). The City does not wish to repeat this.

Figure 9: Servitude at Salt Rock KZN

No space left for supporting amenities.

Through the promotion of nodal development along remaining less altered coastlines, coastal areas will remain accessible to all, and these access points will be supported by the necessary amenities.

4.2 CML informant two: sea-level rise, storm surges and coastal erosion

The City completed a Sea-Level Rise Risk Assessment (SLRRA) in 2009. The intention of the assessment was to:

- Spatially model the predicted sea-level changes in a range of scenarios (time series, incremental climate change, shear events, and storm frequency and intensity);
- Model the form that those changes will take;
- Understand the associated impacts on existing coastal systems, infrastructure and property;
- Provide guidance on and information about implications for future coastal development;
- Identify high risk areas that are prone to high impact, and
- Begin to understand and develop long-term adaptation and mitigation measures against these coastal hazards.

The outcomes of this research has enabled the City to make more informed decisions in terms of future planning, preparedness and the promotion of risk averse decision making along the City's coastline. The term 'risk' in itself is subjective and requires careful consideration. In understanding and managing risk, key questions need to be considered: What is risk? How do different sectors perceive risk? What are the drivers of risk? How is risk experienced and how does it manifest across different scales? In acknowledgement of the complexity of the term 'risk', the City's SLRRA was undertaken in five different phases. These phases included:

Phase 1: Sea-Level Rise Model (March 2008) (Annexure B)
Phase 2: Risk and Impact Identification (May 2008)
Phase 3: Quantifying the Risk (June 2008)
Phase 4: Sea-Level Rise Adaptation + Risk Mitigation Measures (July 2008)
Phase 5: Full investigation of alongshore features of vulnerability on the City of Cape Town coastline (December 2009) (Annexure C)

Whilst the SLRRA examined risk from both a physical and socio-economic perspective through these various phases, Phases 1 and 5 focussed primarily on physical risk and the most appropriate responses to manage this risk respectively. Phase 1 and Phase 5 were therefore key phases in the development of the City's CML in terms of addressing risk from physical coastal processes. More emphasis has therefore been placed on Phase 1 and 5 in this report (full reports provided as Annexures B and C) whilst Phases 2 to 4 in this report are limited to brief descriptions.

4.2.1 Phase 1: spatially modelling sea-level rise and storm surge events through GIS

As a starting point to understand physical risk from sea-level rise and storm surges, a Geographic Information System (GIS) was used to develop the risk model. This model spatially demarcates areas that may be physically impacted upon by storm surges and sea-level rise. This model was developed based on the following scenarios:

- Scenario 1: Present Day Worst Case Scenario;
- Scenario 2: Sea-level Rise Scenarios Into the Near Future, and
- Scenario 3: Sea-level Rise Scenarios after the Collapse of the Polar Ice Sheets.

As there is much uncertainty regarding the timing, extent and acceleration rates of the polar ice sheet melt and the eventual contribution to sea-level rise and coastal erosion, Scenario 3 has not been used to inform the development of the City's draft CML. The report will therefore focus on Scenarios 1 and 2.

Scenario 1: Present Day Very Worst Case Scenarios

This scenario presents the current worse case storm surge and is based on the simultaneous occurrence of an extreme tide[6] and an extreme storm, an event with a nominal return period of 500 years (Brundrit, 2008). Such an event has not occurred along the Cape coast in recent years but it did occur along the KZN coast on 19th and 20th of March 2007. Measurements[7] were taken from this extreme storm in KZN and were incorporated into the Present Day Very Worst Case Scenario, particularly in respect of exposed and very exposed portions of the coastline. Based on the degree of exposure, three inundation levels were determined and built into the model. These three inundation levels (Figure 10) include the following:

- Land Levelling Datum (LLD) +2m in sheltered environments;
- LLD+4.5m above mean sea-level in exposed environments, and
- LLD+6.5m above the mean sea-level in very exposed environments

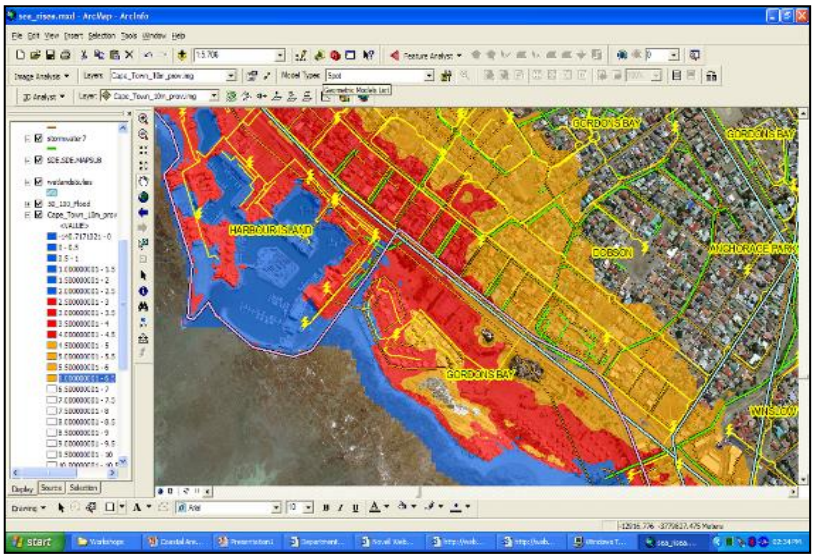

Figure 10: Flood risk scenarios for the City over the next 25 years

The inundation levels in the model are depicted in different colours for analytical purposes namely; blue, red and orange for LLD +2m, LLD+4.5m and LLD+6.5m respectively. With these

[6] Highest Astronomical Tide of the Year (HATOY)
[7] Key statistics include a return period of 30 years and an erosion line consistently located between the 4m and 5m contours.

scenarios, the inundation levels are not considered permanent, but rather as levels of temporary inundation typically experienced during a storm surge event[8].

Scenario 2: The Scenario at the End of the Next Decade

This scenario models the likely trends into the future based on increased storminess and sea-level rise. Global observations indicate a statistically significant rise in sea-level of approximately 50cm over the next decade (Brundrit, 2008). The levels used in Scenario 2 and the details of the inundation to be expected are the same as Scenario 1. However, with the incremental rise in sea-level and the expected increase in storminess[9], it is the return period that is expected to change. Rather than being a Very Worst Case Scenario with a return period of 500 years, Scenario 2 is expected to occur whenever an extreme storm occurs at the same time as any (fortnightly) spring high tide in the spring or autumn (Brundrit, 2008). With the expectation of storms becoming more frequent, in conjunction with the incremental rise in sea-level, the scenario at the end of the next decade becomes realistic rather than an unusual event and hence is used to predict the expected trends for the Cape Town coastline (Brundrit, 2008).

4.2.2 Phase 2: risk and impact identification

The main objectives of Phase 2 of the SLRRA were to:

- Determine the manner in which risk manifests as a consequence of sea-level rise impacts (coastal erosion, direct and indirect inundation of infrastructure, disruption of services, loss of habitat, etc.) and how this will affect the City of Cape Town.

- To develop an understanding of potential sea-level rise impacts based on Scenarios 1 and 2 on the present infrastructure and amenities along the City's coastline. Information was gained through hosting workshops primarily at an operational level across multiple departments responsible for City infrastructure and services, natural resource management, commercial and residential property and policies for ensuring compliance. Information from the workshops provided detail on the linkages between the expected impacts, and consolidated priorities.

4.2.3 Phase 3: quantifying the risk

Phase 3 of this study described and quantified the risk of sea-level rise for the City. This study involved drawing on projections of sea-level rise for the Cape Town coastline based on the projections determined in Phases 1 and 2, and assessing the socio-economic risks that might

[8] This model assumed the coast as a homogenous environment and applied a 'blanket' approach to the entire coastline as the initial investigation. The coastline does however vary and has localised biophysical factors that influence risk. In acknowledgement of this, the City undertook a final investigation in Phase 5 as a means to fine tune this model and disaggrate risk by incorporating the local biophysical factors. The outcomes of Phase 5 are covered in more detail in Section 4.2.5.
[9] Increase in storminess is not restricted to mid-latitude cyclones, but also increases in intensity and duration of south easterlies (and subsequent south easterly driven wave chop) arising from the south Atlantic high pressure system.

be associated with this phenomenon; more specifically, quantifying and detailing the risks to the City of Cape Town and its citizens of sea-level rise over a time period of 5-100 years.

In determining the economic impact, the study relied on a collection of three proxy values – measures as a means to quantify economic loss:

- The first proxy value applied is the loss of real estate as the coastline becomes increasingly exposed to storm surges and existing properties are damaged and vacant land becomes both uninsurable and undesirable for development;
- The second proxy variable applied in this analysis is foregone tourism revenue. The Cape's coastline and beaches contribute to the City's tourism appeal, and
- As a third proxy, the cost of replacing certain public infrastructure that could be damaged by sea-level rise was included.

This economic impact is therefore represented by the formula:

$R_e = f_e \sum$(loss of private property value + loss of tourism revenue + loss of public infrastructure)

Where f_e represents the probability of a sea-level rise event e, where "e" is a sea-level rise event as described in Scenarios 1-3 (Cartwright, 2008).

Table 1: Quantifying the risk based on the flood risk scenarios over the next 25 years

25 years	**Inundation level 1**	**Inundation level 2**	**Inundation level 3**
Seal-level	2.5m	4.5	6.5
Probability in next 25 yrs.	95%	85%	20%
Threatened value	R5.2 billion (US $500 million)	R23.8 billion (US $2.3 billion)	R54.8 billion (US $5.4 billion)
Value at risk	R4.9 billion (US $490 million)	R20.2 billion (US $2 billion)	R11.0 billion (US $1.1 billion)

It should be noted that the City is unlikely to be confronted by the full extent of these costs in a single storm surge event; that would require the simultaneous impact from a storm surge at all points around the coastline and we know that due to local biophysical conditions that vary greatly along the City's coastline, the run-up of such events will vary significantly according to the location of the coast. Rather, the figures represent the cumulative risk and costs over a 25-year period at all points along the coast (Cartwright, 2008). In addition to this, these values are based on the assumption that the loss of tourism revenue, property and infrastructure is absolute rather than partial.

4.2.4 Phase 4: sea-level rise adaptation and risk mitigation measures

Phase 4 of the report aimed to identify adaptation and management measures to lower the risk profile of the City. This was undertaken by assessing the broad costs and merits of different

approaches used to counter the impacts of sea-level rise in conjunction with storm surge events. It was found that the risk of sea-level rise could be significantly reduced by proactive socio-institutional responses to the problem. The Phase 4 report has outlined a number of measures and their costs and benefits that could be considered to reduce sea-level rise and storm surge risk for the City of Cape Town under the categories of:

- First resort: No regrets options – a risk averse approach;
- Second resort: Additional socio-institutional measures – i.e. development of CMLs;
- Third resort: Additional biological measures – an ecosystems based management approach, and
- Last resort: Additional physical measures – the use of hard engineering structures.

Based on the identification of the various adaptive options, comprehensive feedback was provided to officials that participated in the workshops held for Phase 2. This provided an enabling platform for a participatory approach with multiple stakeholders to determine trade-offs that might arise from the implementation of climate change adaptation measures. Further to this, this phase substantiated the importance of proactive measures and the potential long term consequences of deteriorating economic conditions from runaway climate change (Cartwright, 2008).

4.2.5 Phase 5: investigation of longshore features and adaptation options

Phase 5 of the SLRRA consisted of two reports. The first report was used to further refine the model generated in Phase 1 through the consideration of local biophysical factors that influence risk from storm surge events. The report distinguished areas in terms of their exposure to risk based on alongshore features such as wave set-up and wave run-up, wave shoaling, off-shore bathymetry, swell diffraction into shadow zones, focussing effects, coastal geomorphology as well as the extent and nature of coastal development. Included within this report are how these local biophysical factors interact with each other and how these interactions affect degrees of risk.

Based on this report, a total of 19 locations (Tables 2, 3 and 4 and Figure 12) were identified as being vulnerable. The vulnerability was determined by a binary assessment of four biophysical factors, namely wave-setup, wave run-up, coastal geology and development risk. A score of 1 was allocated to those areas that are perceived to be exposed to storm surges, and a score of 0 was given if the location is not exposed to that component. The assessment was conducted using the expert opinion of a group consisting of local oceanographers, coastal management practitioners and engineers, all of whom were drawing on in-depth knowledge of the city's coastline. The assessment not only provided a reasonable measure of the total sea-level rise risk at a given location, but it also provided important insight into the specific nature of sea-level rise risk at different locations.

Table Bay

Table Bay is an area of gently sloping bottom contours and a sandy coast fringed by low dunes and occasional rocky outcrops. Part of the coast is sheltered by Robben Island. The coast is

eroding in the south, and is particularly vulnerable where it is backed by the lagoon of Diep River.

Table 2: Components of sea-level rise vulnerability for Table Bay

Location	Wave set-up	Wave run-up	Coastal geology. Hard or soft surfaces.	Development risk	Comment
Melkbosstrand	1	0	0	1	Exposed to big swell, but with some shelter from offshore reefs and a shallow bathymetry. Beachfront development and dune removal is problematic.
Blouberg (Bay)	1	0	0	1	Sheltered behind Robben Island, the beach should be an area of sand accretion. However, extensive development has encroached too close to the waterline. Protection is needed.
Tableview beachfront	1	0	0	1	Exposed to big waves, where the Beach Road will become at risk. Protection is needed.
Milnerton beach	1	1	0	1	Exposed to big waves and, at high tide, surging breakers. This is an eroding beach with a diminishing steep dune cordon. Potential major issue if the protection to Otto du Plessis Drive is lost.
Milnerton to harbour	1	0	1	1	Shadow zone, no big waves. Harbour construction has led to gradual erosion and CML, with on-going loss of coastal infrastructure. Sea wall needs constant maintenance. Oil pipeline is strategic.

Atlantic Coast

The Atlantic Coast is a rocky coast with cliffs, offshore reefs and extensive kelp beds. Deep water is found close to the shore, permitting big waves to crash onto the coast so that protection is needed for any infrastructure at sea-level.

Table 3: Components of sea-level rise vulnerability for the Atlantic coast

Location	**Wave set-up**	**Wave run-up**	**Coastal geology. Hard or Soft Surfaces**	**Developme nt Risk**	**Comment**
Green Point & Sea Point	1	0	1	1	Exposed to big waves, but some shelter from offshore reefs. The coast is on an exposed wave cut platform at some height above the sea, but needs the protection of a strong sea wall requiring continuous maintenance.
Glen Beach	1	0	0	1	A small pocket beach with some protection. High value beach houses are exposed.
Camps Bay	1	1	0	1	This beach is exposed to big waves. Wide beach, but high sea-levels can reach the Beach Road.
Bakoven cottages	1	1	1	1	Very exposed to big waves and wave run up, and constantly under threat, as the houses are low down and on a hard rocky surface.
Kommetjie	1	1	0	1	Very exposed as deep water close inshore. Development has taken place in the protective dune field, reducing its effectiveness.
Witsands	1	1	0	0	Very exposed single building in dynamic dune field.

False Bay Coast

The western side of False Bay is steep and well sheltered from waves approaching from the south west. Within False Bay, the bottom contours are gently shoaling to the sandy northern shores. The eastern side of False Bay is steep.

Table 4: Components of sea-level rise vulnerability for the False Bay coast

Location	Wave set-up	Wave run-up	Coastal Geology. Hard or Soft Surfaces	Developme nt Risk	Comment
Glencairn	1	0	0	1	Railway line running along a low wave-cut platform. Sheltered in shadow zone, but perhaps the foundations of the railway line in the backing wetland need continual maintenance.
Fish Hoek dune section	1	0	0	0	In shadow zone, but backing wetland may lead to vulnerability.
Kalk Bay	0	1	1	1	In shadow zone from southwest, but exposed to focussing from the south-east, so that harbour provides some protection.
Muizenberg corner	1	0	0	1	In the edge of the shadow zone, but protected by a wide and very flat beach with spilling breakers.
Strandfontein – Baden Powell Drive / Treatment Works / Landfill	1	0	1	1	Not too exposed but the road and the infrastructure are too close to the water's edge.
Monwabisi and Macassar Pavilions	1	1	0	1	Exposed to surging breakers at high tide and during storm events, with erosion of dune field.
Strand (entire beach front)	1	0	1	1	Exposed beach with protection from offshore reefs, but infrastructure constructed close to water and poorly planned sea-walls.

Bikini beach	1	0	0	1	In swell shadow, but infrastructure too close to water and needs protection. Beach sand erodes.

The identification of the vulnerable areas based on the influence of local biophysical factors and the subsequent disaggregation of risk has been key to the process of understanding risk at a localised scale. A great deal of risk from sea-level rise and storm surges can be removed by timely interventions, but deciding exactly how to respond and who should take responsibility is difficult. The second report of Phase 5 therefore focussed on determining ways and means of ensuring a coherent and strategic approach towards prioritising actions and promoting consistent decision making with respect to managing this risk. The nature of risk from sea-level rise and storm surge events requires that CMLs are complimented by additional regulatory mechanisms. A holistic overview of coastal regulatory mechanisms and how they link together is provided in Section 8.

4.2.6 Comparative study: actual wave-run up vs. modelled predictions

This study was undertaken as an addendum to Phase 5 of the SLRRA. On the 31st August 2008 the city experienced an extreme storm surge event. A sub-tropical cyclone developed approximately 600km west of Cape Town and at the same time a secondary severe low pressure system also developed which resulted in a case of explosive cyclogenesis. The combination of these low pressure systems resulted in significant erosion and damage to infrastructure along the city's coastline (Figure 11).

Figure 11: Storm surge event on the 31st August 2008

Coastal erosion at the Milnerton Golf Clubhouse.

The purpose of this study was to draw a comparison between actual wave run-up[10] heights at vulnerable locations (Figure 12) experienced by the 2008 storm with the City's model as well as the model developed by Mather *et al* used to predict extreme wave run-up heights.

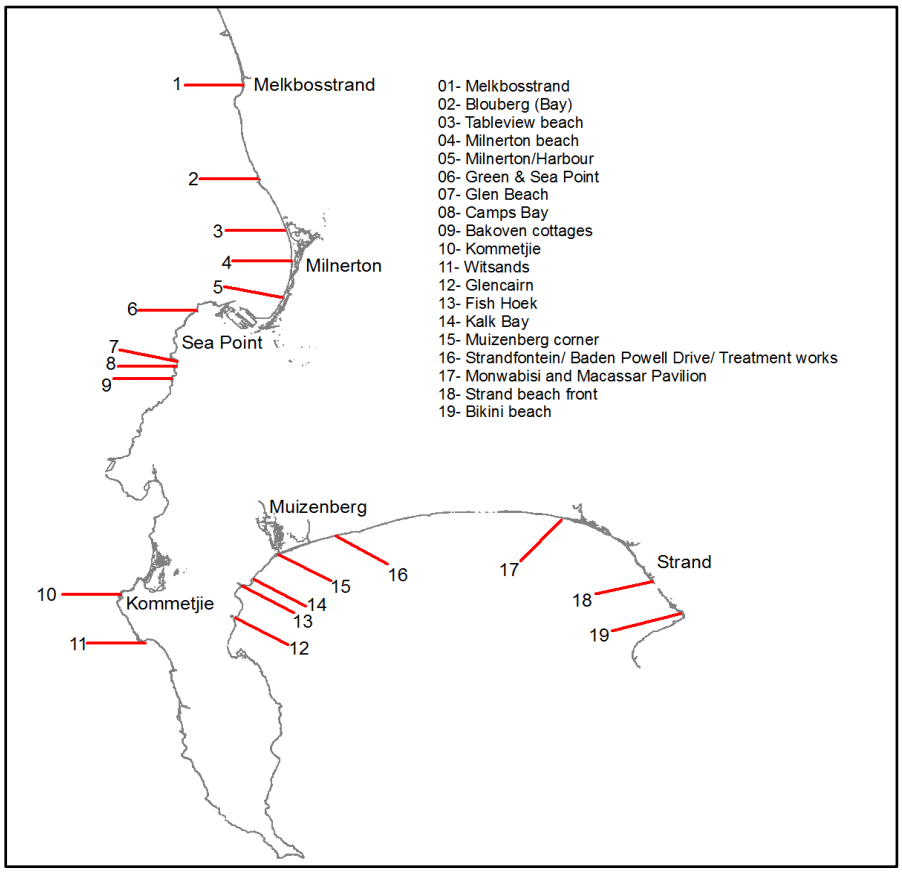

Figure 12: Vulnerable areas of the City's coastline

Being able to accurately predict wave run-up heights is an important component in the development and placement of CMLs. The Mather *et al* model is generally accepted as the most robust wave run-up model in South Africa and as such was used for one of the comparisons. The model uses distances offshore x_h to water depth *h* to estimate a near-shore profile slope as $S = h/x_h$ where the depth of closure is the suggested choice for *h*. Extreme run-up R_x is then expressed in terms of S as $R_x/H_0 = CS^{2/3}$ (Mather *et al,* 2011)(Figure 13).

[10] Extreme wave run-up may be defined as the maximum level, relative to the still water level reached by a wave or by a series of waves (Mather, *et al*, 2011).

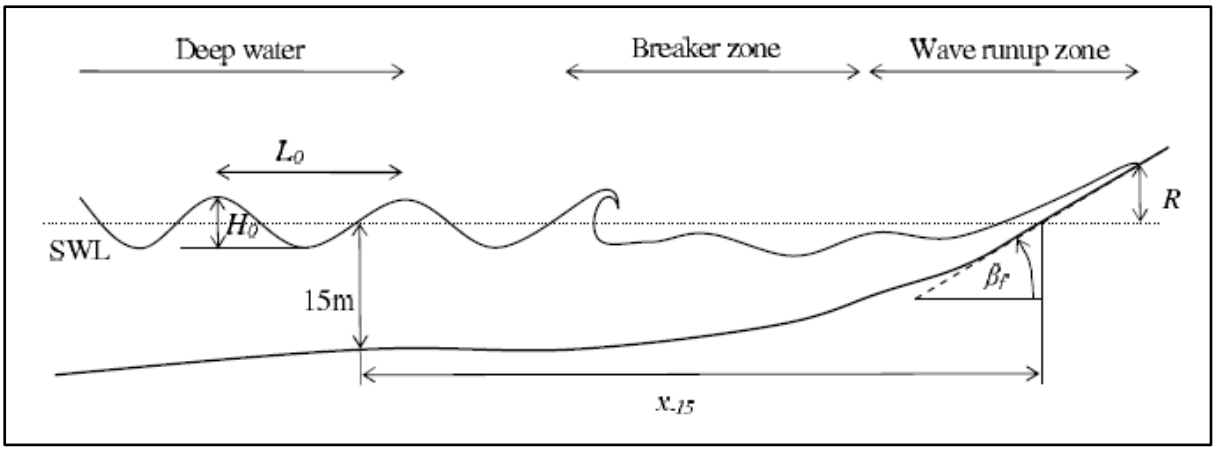

Figure 13: Parameters used in the Mather *et al* model

R is the run-up value, x_{15} is the chart distance from the shoreline to the 15m isobath, H_0 is deep water significant wave height (Source: Mather et al, 2011).

In the equation as $R_x / H_0 = C S^{2/3}$, C is a dimensionless coefficient that is used to predict wave run-up based on different coastline types. Figures for upper/lower bounds and median values are shown in Table 5.

Table 5: Coefficients for the various types of coastline used in the Mather *et al* model

Coastline Type	Upper Bound	Median	Lower Bound
Open coast	$C = 10$	$C = 7.5$	$C = 3.0$
Large embayment	$C = 10$	$C = 5.0$	$C = 3.0$
Small embayment	$C = 10$	$C = 4.0$	$C = 3.0$

(Source: Mather *et al,* 2011)

In the comparative study the coefficients used in the model were selected in accordance with the median values as suggested by Mather *et al*. The results indicate that there is some variation between the predicted wave run-up between both the City's as well as the Mather *et al* model and the actual wave run-up measurements taken from the August 2008 storm surge event (Annexure D). In some instances actual wave run-up exceeded the predictions from both models (Figure 14) and in other areas, the actual wave run-up was less than the height predicted.

Figure 14: Hout Bay - modelled risk compared with a real life event.

Actual wave run-up height measured with a differential GPS from the 31st August 2008 storm surge event overlaid with the City's SLRRA model.

The variation in results between an actual event and modelled predictions are to be expected. This is because there are a number of variables that may have non-linear relationships that interact over time and space. This complexity cannot be adequatly represented by an empirical model. Some of these anomolies include scalar influences in identifying the appropriate coefficicent value to represent coastline type, the influence of wave set-up and tidal levels during the event and local oceanographic and atmospheric influences, such as swell refraction, swell shadow, wind direction and wind strength during the event. Additional surf zone influenes include infra-gravity waves, swash action and incident wave energy that may influence wave run-up height (Mather, *et al* 2011). Lastly, and perhaps most critically, is the influence of erosion that may take place during a storm surge event. Erosion during an event alters the beach and dune profile which will influence wave run-up heights. In addition to this, overtopping rates, especially in cases where the topography may subside landward of the dune cordon, may increase during a storm surge event.

Based on the results from these comparisons , the following may be deduced:

- Risk based on modelled outcomes should be treated as indicative rather than definitive;
- Risk cannot be pinpointed absolutely: there are a number of influencing variables that may interact over temporal and spatial scales with non-linear relationships that cannot be measured absolutely, and

- The results highlight the importance of ground truthing and taking into consideration the influence of local biophysical factors as opposed to applying models across broad scales based on a desktop analysis.

4.3 CML informant three: coastal dynamic processes

There are a number of processes that make the city's coastline a highly dynamic space. At a broad scale, these processes are largely driven by the two major atmospheric conditions: namely the sub-tropical-driven cyclones in winter and the mid-Atlantic high pressure system driving south easterlies in summer. The following processes were identified to determine the dynamic coastal process zone along Cape Town's coast:

- Wind-blown sand and migrating dune systems;
- Migrating estuary mouths, and
- Coastal erosion.

Key to identifying and understanding the behaviour of these processes was the local knowledge of municipal authorities. This knowledge was gleaned from a core group of municipal coastal practitioners that have a combined experience of 60 years of managing the city's coastline. Understanding these processes through this detailed knowledge is fundamental in planning for coastal processes through the use of CMLs.

4.3.1 Wind-blown sand and migrating dune systems

Historically speaking, many of Cape Town's dune systems were highly mobile wind-driven systems which migrated inland beyond the existing urban coastal fringe. This extensive development has had two primary consequences. Firstly, many coastal processes, such as sediment by-pass systems, are no longer functioning which in turn is having an impact on sediment budgets along the city's coastline (Figure 15). In some regions this is resulting in beach regression and coastal erosion. The second impact of this extensive development is that the space in which these dynamic processes function, has been encroached upon. As the drivers of these migrating dune systems are by and large still in place i.e. south easterly winds and sediment supply from the sea, these migrating systems are constantly in the process of reforming in the remaining littoral active zone in an attempt to follow their historic pathways. The end result is the encroachment of sand onto coastal infrastructure and property.

Given the context that Cape Town has developed into a metro, the City has applied a practical approach towards delineating coastal dynamic zones. Whilst these zones have the potential to re-establish themselves to their historical pathways, allowing them to do so would have major financial and service delivery implications to the city and its citizens.

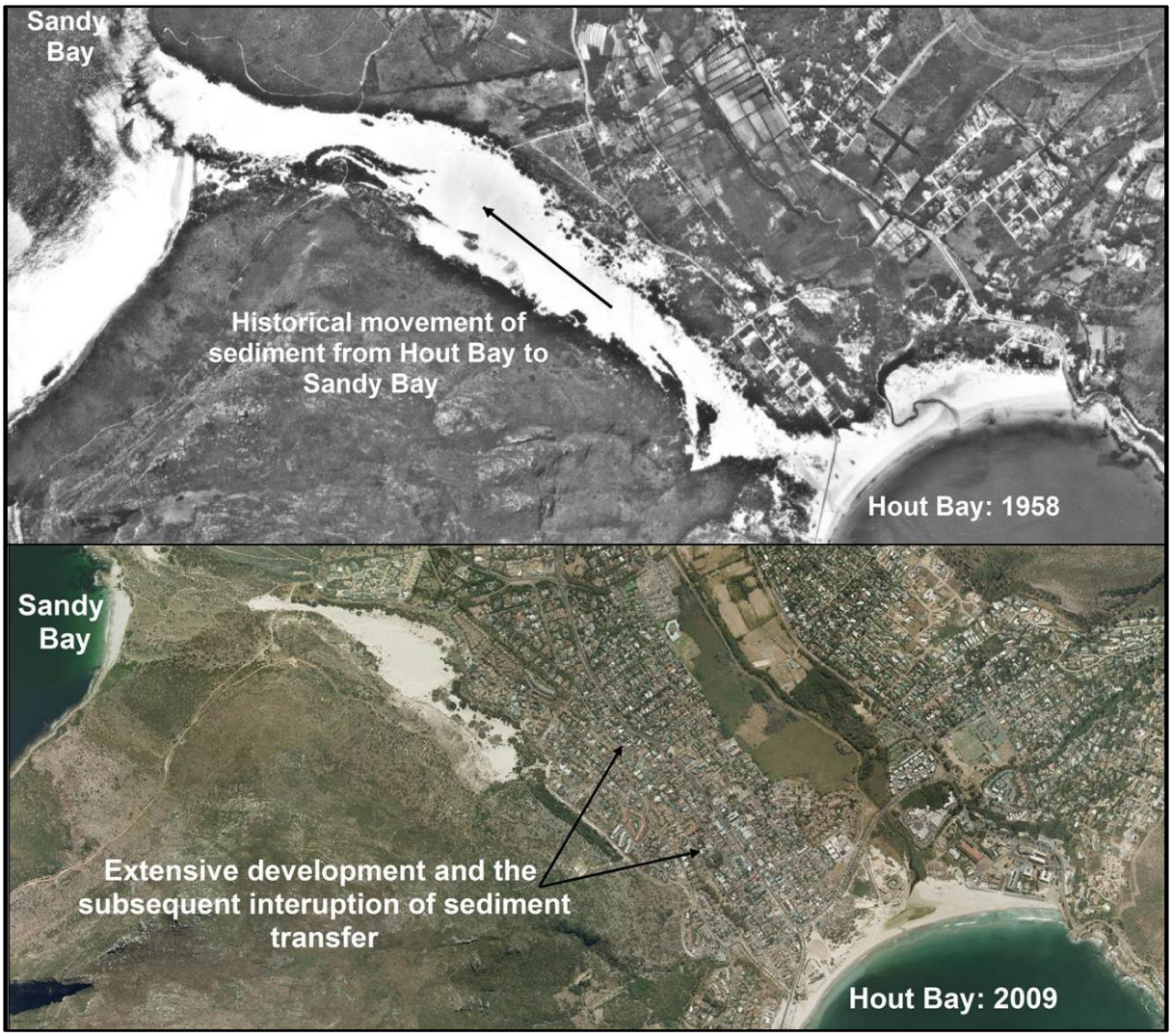

Figure 15: Historic sediment by-pass system in Hout Bay

Development has severely compromised this sediment by-pass system.

Due to the extent the City's coastline has been developed and considering the impracticality of relocating infrastructure from these dynamic spaces, the City cannot re-establish these historical pathways. Instead the City has used the draft CML to demarcate remaining dynamic spaces and within these remaining spaces apply management interventions to mitigate the impacts of these dynamic processes on the built environment (Figure 16).

Figure 16: Position of the draft CML in Hout Bay

An example of demarcating remaining dynamic systems in Hout Bay. The CML has been positioned along the urban fringe where such systems will be actively managed.

Conversely, in peri-urban and rural areas, where existing wind-driven dune systems are largely in-tact, the CML has shifted further inland to demarcate these spaces (Figure 17) as a means to prevent the same mistake of inappropriate development (Figure 2, 5, 11 and 18 refers) in dynamic zones from recurring into the future.

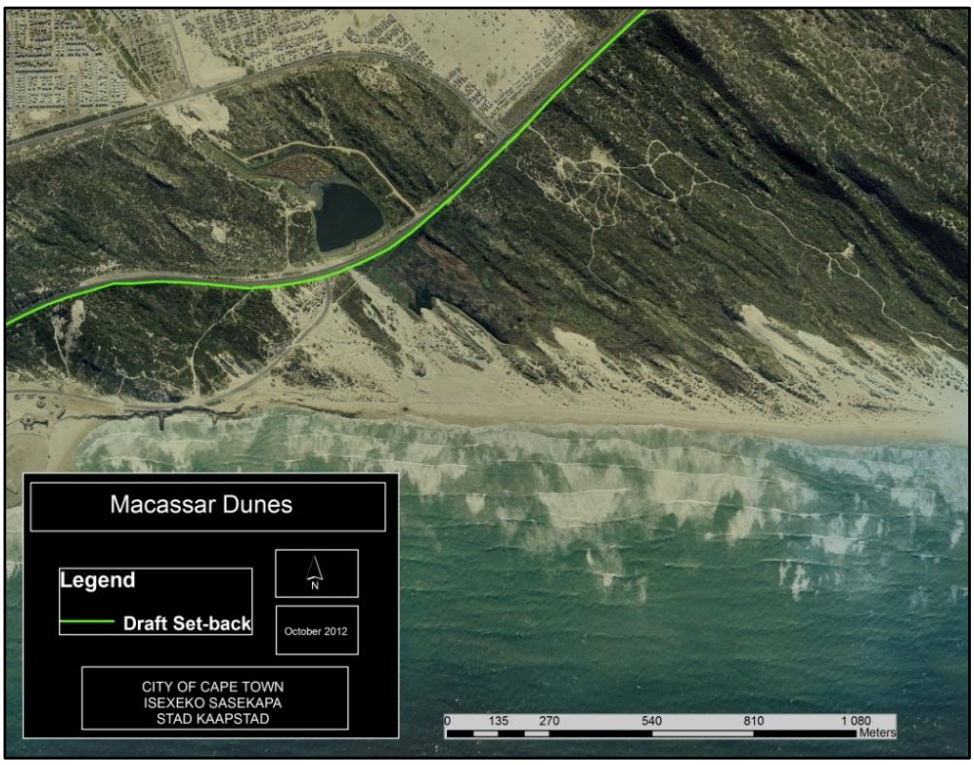

Figure **17**: Position of the draft CML in Macassar

It would be unwise to allow development seaward of the draft CML due to the presence of a highly dynamic wind-driven sand environment and the social risks that would arise as a consequence.

4.3.2 Migrating estuary mouths

The direction, timing and rate of migrating estuary mouths are impossible to predict. The City of Cape Town has numerous estuaries that are subject to this unpredictable movement. In the past, such migration has resulted in coastal erosion which in turn has undermined and damaged critical infrastructure (Figure18).

Figure 18: Macassar Pavilion and the Eerste River

Damage to the Macassar Pavilion (foreground) and a sewer pump station (background) due to the westward migration of the Eerste River mouth.

As a consequence of the potential destruction that migrating mouths may cause together with their unpredictable nature, the City's CML has been positioned with the intent to create space to allow estuaries to migrate as they would naturally do along less altered stretches of the City's coast. Whilst conservative estimates may be applied in defining areas in which estuaries are expected to migrate, the presence of private property in close proximity to some estuaries (typically in developed stretches of the coast – Figure 19 refers) necessitates that the same principle is applied whereby the CML, as a means to avoid the legal implications that may arise as a consequence of the position of a CML in relation to private properties with development rights, is defined on the estuary side of the cadastral boundary of those properties. Whilst this approach avoids the legal difficulties, properties located landward of the CML adjacent to estuaries may still be at risk to estuarine related risk: i.e. erosion, storm surge induced flooding etc. Again CMLs in isolation are not equipped to respond to existing infrastructure at risk and requires the application of planning mechanisms to manage the complex matter of existing property at risk to coastal hazards. In these cases, overlay zones will be developed and applied. Overlay zones are discussed in more detail in Section 8.1.1.

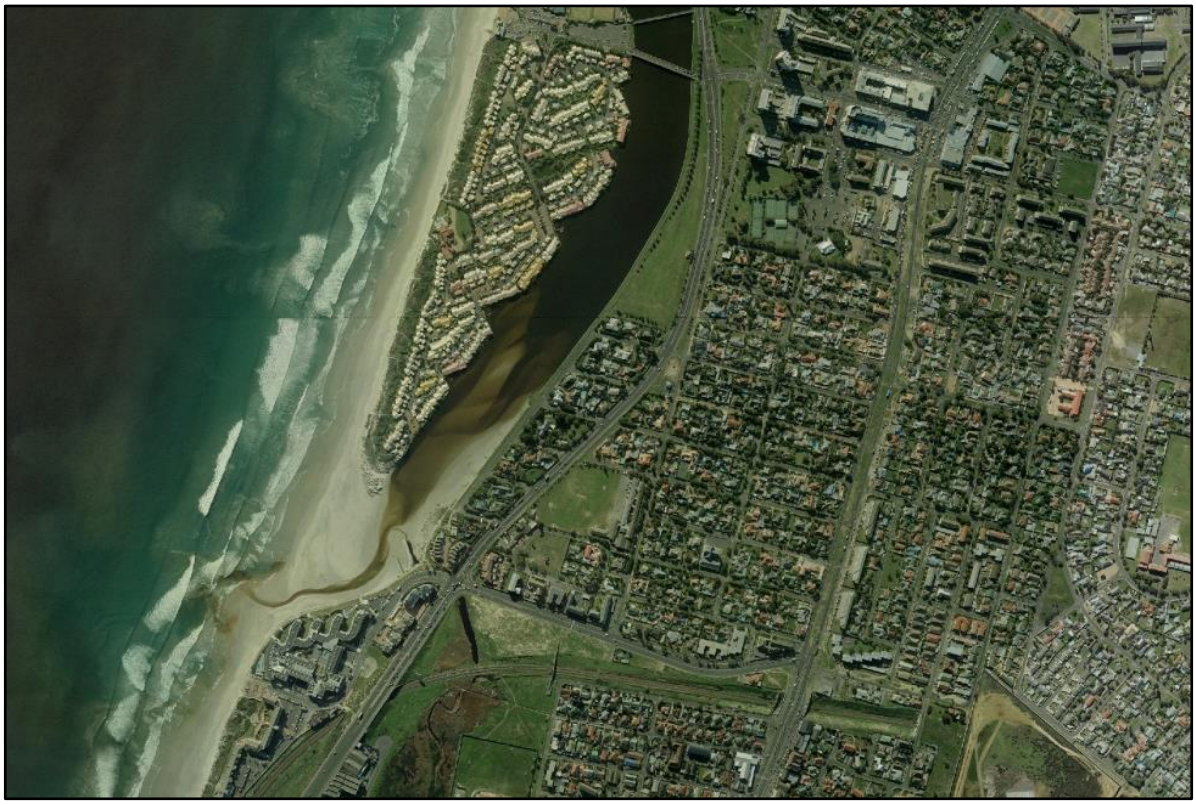

Figure 19: Diep River Estuary

Estuary mouths in built up areas are no longer able to migrate as they would naturally do.

4.4 CML informant four: scenic drives, aesthetics and sense of place

The City is world renowned for its aesthetics and coastal beauty. Much of Cape Town's beauty is witnessed in transit along Cape Town's extensive road network. However, development that has no regard for or does not contribute to the value and experience of scenic routes tends to have a significant negative impact on Cape Town's scenic value. It is for this reason that the City has implemented a Scenic Drive Network Management Plan (SDNMP). This management plan identifies routes which traverse areas of outstanding scenic quality in Cape Town and attempts to establish a sustainable balance between the conservation of its associated natural and built amenities and the development of the tourism and recreational potential linked to these routes (CCT, 2003).

The SDNMP has identified a total of 57 scenic routes throughout the City, 17 of which fall within or border[11] the City's coastal draft CML (Table 6).

Table 6: Scenic Drive Routes falling wholly or partially within the City's draft CML

Route	Route Name	Start Point	End Point
2	Main Road	Smitswinkel	Muizenberg

[11] The management unit of a scenic drive consists of the Scenic Drive Envelope (SDE). The SDE consists of carriageway, the road reserve immediately adjacent public land and the first erven abutting any of these.

4	Witsand Main Road	Plateau Rd	Slangkop Rd
5	Soetwater Main Road	Witsand Rd	Slangkop Rd
6	Slangkop Road	Kommetjie	Witsand Main Road
7	Glencairn Expressway	Main Road	Kommetjie Main Road
11	Chapman's Peak Drive	C. Peak Hotel	Die Hoek Lookout
16b 17a	Princess Street Victoria Rd	Victoria Rd Victoria Rd	Hout Bay Main Rd Princess Street
17b	Victoria Road	Victoria Rd	Bakoven
17c	Victoria & Beach Roads	Bakoven	Portswood
18	Camps Bay Drive	Kloof Nek	Victoria Rd
25a	Atlantic & Roal Roads	Atlantic/Main Rd	Sunrise Circle
25b	Baden Powell Drive	Main Road	CCT boundary
35	Melkbosstrand Road	N7	West Coast Road R27
36a &b	Otto Du Plessis Drive	Melkbos urban area	Marine Drive
36c&d	Marine Drive R27	Otto Du Plessis	Racecourse Rd
38a	R44 / Beach Rd-North	Study area boundary	Lourens River Crossing
38b	R44 / Beach Rd-East	Lourens River	Beach/Faure Marine Dr

Whilst the priority of the CML is to reduce risk to the City, the alignment of the CML with scenic routes along sections of Cape Town's coastline will compliment and assist both the SDNMP and the ICMA (section 25(1)(a)(iii)).

4.5 CML informant five: biodiversity network

The City's Biodiversity Network (BioNet) has been approved nationally as a fine-scale plan for the City. The BioNet, in conjunction with the need to promote access to coastal resources, is the central pillar to the CML in less altered stretches of the coastline. The BioNet has been used as the 'baseline' layer from which to achieve the broader objectives of the CML. For this reason, the City has ensured that the draft CML, as far as possible, is aligned with the BioNet along the coastal fringe. This alignment is critical to ensure that the objectives of both the BioNet and the CML are achieved under a single strategy.

The determination of the BioNet was based on the National Vegetation Type target percentages as determined for the 2004 National Spatial Biodiversity Assessment and was applied at the city level to recognise vegetation subtypes (CCT, 2009). The preservation of the BioNet is fundamental towards addressing the following socio-economic imperatives:

- Retaining aesthetics and sense of place (cultural benefit);
- Improving the buffer potential against storm surges, coastal erosion and wind-blown sand as a means to reduce the social risk and build resilience (regulatory benefit);
- Improve the recreational and amenity value of the coast (provisional benefit), and
- Promote equitable access to the coast through the retention of green corridors as opposed to strip development (cultural).

The BioNet was determined in 2009 through a systematic conservation planning approach as a means to prioritise remnant indigenous vegetation based on factors of connectivity, habitat condition, and location of rare and endangered flora (CCT, 2009) (Annexure E). A product of the systematic conservation planning approach was the BioNet GIS shapefile. The BioNet GIS shapefile was generated through a combination of software tools, namely C-Plan and Marxan. After extensive ground truthing of vegetation remnants from 2007 to 2008, C-plan was run using habitat condition as an additional informant. Following this analysis Marxan was applied. A key attribute to the Marxan software is its capability (through the Boundary Length Modifier Tool) of identifying additional remnants required to improve connectivity among selected remnants and thus determine feasible corridors in the BioNet[12] (CCT, 2009).

Biodiversity corridors are important in preserving ecological processes such as the dispersal and migration of plants and animals which in turn is necessary to conserve healthy populations in the long term (CCT, 2009). In acknowledgement of the importance of these corridors, the City's draft CML was defined based on the presence of corridors in the coastal belt. Where the BioNet corridors abutted the coast, the CML was delineated on the landward side of these corridors (Figure 20). The BioNet is the nationally recognised fine scale conservation plan; as such it must be integrated with the CML line.

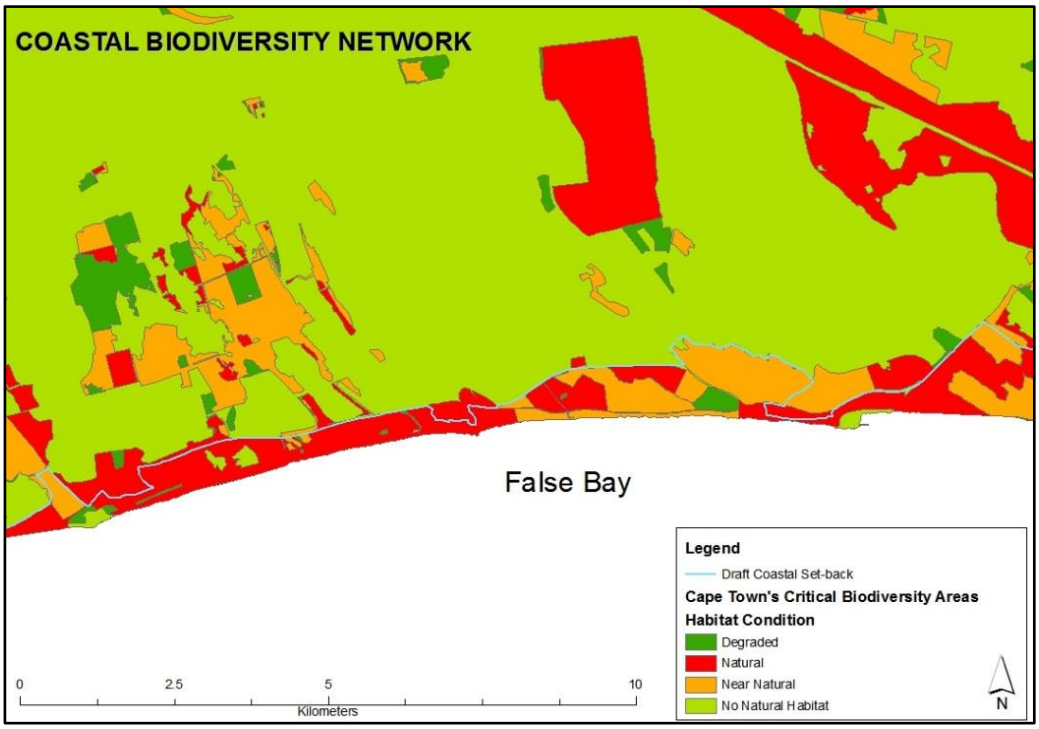

Figure 20: The City's biodiversity network overlaid with the draft CML

The presence of biodiversity corridors in the coastal belt was a key informant to defining the City's CML. In this case the CML is positioned to include a critical corridor between Strandfontein and Macassar.

[12] In addition to the identification of corridors, the conservation planning analysis through the application of C-Plan and Marxan also identified 59 different vegetation types in the city. These vegetation types were in turn categorised according to conservation status. A total of 10 categories were identified. Further detail on this is available in Annexure E.

5. ESTUARIES

A total of 12 estuaries have been identified for inclusion within the City's CML (Table 7).

Table 7: Estuaries identified within the City of Cape Town

	Name	**Location**	**Coordinates**
1	Sout River	Melkbosstrand	18˚26'40.464"E and 33˚42'47.927"S
2	Diep River (Rietvlei)	Milnerton	18˚29'4.598"E and 33˚53'22.89"S
3	Disa River	Hout Bay	18˚21'22.202"E and 34˚2'40.636"S
4	Bokramspruit	Kommetjie	18˚19'57.633"E and 34˚8'3.659"S
5	Else River	Glencairn	18˚25'53.349"E and 34˚9'37.508"S
6	Silvermine River	Fish Hoek	18˚26'40.464"E and 33˚42'47.927"S
7	Zandvlei	Muizenberg	18˚26'20.122"E and 34˚7'77.946"S
8	Zeekoe	East Beach	18˚30'17.762"E and 34˚5'54.308"S
9	Eerste River	Macassar	18˚45'13.402"E and 34˚4'43.777"S
10	Lourens River	Strand	18˚48'39.034"E and 34˚6'0.187"S
11	Sir Lowry's River	Gordon's Bay	18˚51'53.622"E and 34˚9'20.016"S
12	Steenbras River	Steenbras Nature Reserve	18˚49'9.883"E and 34˚11'41.348"S

The City's CML has only been defined within City administered land. Thus estuaries falling within Table Mountain National Park (TMNP) (Table 8) were not included in the City's estuary delineation process.

Table 8: Estuaries falling within Table Mountain National Park

	Name	Location	Coordinates
1	Wildevoelvlei River	Kommetjie, TMNP	18˚20'35.833"E and 34˚7'38.679"S
2	Schuster River	Cape Point, TMNP	18˚22'15.265"E and 34˚12'7.361"S
3	Krom River	Cape Point, TMNP	18˚22'42.243"E and 34˚13'51.391"S

4	Buffels River	Cape Point, TMNP	18˚27'42.415"E and 34˚19'5.653"S

Besides those rivers located within TMNP, the only other river that has been excluded from the CML delineation process is the Salt River in the Paarden Eiland industrial complex. The Salt River is canalised and is not considered a functional estuarine system. Whilst there is a risk element of flooding from the Salt River canal, this element is addressed through the City's Floodplain and River Corridor Management Policy and Storm Water By-law (Section 5.2, Annexure F and G respectively).

5.1 Method: delineating the City's estuaries

Water courses that are classified as being either permanently or temporally open to the sea are defined as estuaries. The spatial extent of estuaries, in terms of the requirements of the ICMA, may be defined based on a variety of parameters. These parameters may be split according to two broad categories: the inland reach of estuaries (vertical) and the width of estuaries (lateral). The vertical extent of estuaries is determined by:

- The inland point at which tidal influence is no longer measurable, or
- The inland point at which salinity is measurable higher as a consequence of the influence of the sea, or
- The landward most limit of either of the influences (whichever influence penetrates furthest inland).

The lateral extent of estuaries may be defined based on the following parameters:

- The location of the 50-year flood line in relation to the estuary up to the estuaries inland limit, or
- The location of the 5m contour in relation to the estuary up to the estuaries inland limit, or
- The spatial extent to which vegetation associated with estuarine environments is present.

A status quo analysis of data sources applicable to estuarine delineation was undertaken (Table 9). The following data sources were identified:

- Van Niekerk, L., & Turpie, J. K. (2012). *South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component*. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch (Annexure H)
- Catchment Management Department, City of Cape Town: 50 and 100-year delineation of selected estuaries (Due to the sheer size of these reports, they have not been included as annexures. They are however available upon request).
- Geomatics Department, City of Cape Town: Digital Elevation Models extracted from LiDAR data (spatial data available upon request).

Table 9: Analysis of data sources available for estuary delineation

Data source	Description	Advantages	Drawbacks
Catchment Management Department, City of Cape Town: 1985-2003	50 and 100-year estuary floodlines were determined by external consultants commissioned by the City. These delineations were based on advanced modelling which considered a wide range of factors.	*Reliability*: In-depth detailed studies conducted by external consultants taking into account a wide range of factors (e.g. topographical surveys, backwater analyses, surface roughness coefficients and vegetation cover). *Transparency*: Detailed meta-data available in all cases but one (Disa River, Hout Bay)	*Reliability*: Studies sometimes conducted as long ago as 1985. Floodplain for the entire river, not only the estuary, needs to set a boundary inland. *Transparency*: Lack of meta-data in the case of the Disa River.
CSIR 2011	Delineations based on digitized Spot 5 imagery (dating back from 2008), the estuaries' lateral boundaries were delineated based on "associated wetlands, intertidal mud and sand flats, beaches and foreshore environments that are affected by riverine or tidal flood events" (Edgar 2000, cited in Van Niekerk and Turpie 2011, p.31) as well as 5-meter contours from the Chief Directorate Surveys and Mapping, or digitized based on orthophotos when the Directorate data was lacking. "Where no orthophotos were available (13 systems[13]), floodplains were mapped from Spot 5 imagery using changes in topography and	*Validity:* Data up to date, as lines drawn in 2011, some floodplains were delineated based on on-site inspections.	*Reliability*: Study takes into account a smaller account of input factors, coarse delineations. 5-meter contours were used, but not as accurate as elevations generated by LiDAR data. *Transparency*: The CSIR has not detailed which methodology, or combinations of methods it has applied per estuary.

[13] Within the City, this applied only to the Steenbras River.

	vegetation types as indicators. The estuary mouth was taken as the downstream boundary of an estuary or, where the mouth was closed, the middle of the sand berm between the open water and the sea. The upstream boundary was determined as the limits of tidal variation or salinity penetration, whichever penetrates furthest. Wherever possible the upstream boundary was derived from the literature, expert judgment or field observations". (Van Niekerk and Turpie 2011, p. 31-32).		
Geomatics Department, City of Cape Town: 2009	Digital Elevation Models in raster format (pixel size of 2*2) extracted from LiDAR remote sensing data, and useful for delineating extremely accurate contours.	*Accuracy*: LiDAR data- (XY +- 30cm, Heights +- 15cm), and 5m contours generally a good proxy for delimitating 50 year floodplains (Van Niekerk and Turpie 2011, p. 34-35).	*Validity*: coarse, only takes into account topography, not other factors such as soil porosity, vegetation cover, much space for interpretation (where to set the estuary mouth).

The City, through the application of GIS, overlaid the relevant spatial layers per estuary for the entire coastline of Cape Town. The individual analysis of each estuary in relation to the spatial data allowed the City to develop a holistic perspective of the spatial extents, both vertically and laterally, of the 12 estuaries. Based on this analysis, each estuary was delineated as part of the City's CML.

5.1.1 Developed flatlands: flood lines and the 5m contour

Some of the City's estuaries are located in areas where the topography is flat. Notably this includes estuaries along the False Bay coastline, in particular the Zandvlei, Zeekoe, Eerste and Lourens estuaries. Applying the 5m meter contour to define estuaries in these instances

becomes problematic as, due to the flat topography, the 5m contour includes extensive areas. The extent of these areas defined by the 5m contour is not representative of estuaries, estuarine vegetation nor does it provide a realistic representation of the area prone to flood risk. Though using the 50-year flood line refines the spatial extent, the 50-year flood line still includes significant areas that are developed adjacent to estuaries. These developed areas which are at risk to a 50 or a 100-year flood event, have not been included within the City's CML. The same principle (as described in more detail in Section 3.3) applies whereby the City wishes to avoid impacting on development rights through inclusion of such areas within its CML. A CML is not equipped to solve and address the issue of existing development at risk and as such requires a more comprehensive planning mechanism in an overlay zone (discussed further in Section 8.1.) Such areas are also addressed through the Floodplain and River Corridor Management Policy (section 5.2 refers).

5.2 Beyond estuaries: the role of the City's Floodplain and River Corridor Management Policy and Storm Water By-law

Flood lines determined by the City's Catchment Management Department extend beyond estuaries and include water bodies within catchment headlands. These flood lines are supported by regulatory mechanisms developed by the City's Roads and Storm Water Department. A Floodplain and River Corridor Management Policy was approved by Council on the 27th of May 2009 and has been incorporated into the City's Integrated Development Plan. At a broad level, the policy, aims to:

- reduce the impact of flooding on community livelihoods and regional economies, and
- safeguard human health, protect natural aquatic environments, and improve and maintain recreational water quality

This policy in turn is regularised through the Storm Water Management By-law. Within the by-law, "Storm water system" is defined as:

"…both the constructed and natural facilities, including pipes, culverts, water courses and their associated floodplains, whether over or under public or privately owned land, used or required for the management, collection, conveyance, temporary storage, control, monitoring, treatment, use and disposal of storm water" (CCT, 2009).

The inclusion of "water courses and their associated floodplains" captures estuaries within the definition of a storm water system. Thus both the policy and the by-law become applicable to not only water bodies such as inland rivers, but estuaries too in a manner that:

- "limits or reduces exposure to flood risk by avoiding hazardous, uneconomic or unwise use of floodplains, thereby protecting life, property and community infrastructure;
- Protects and enhances the intrinsic value and the environmental goods and services provided by watercourses, wetlands and associated riparian areas and floodplains;
- Facilitates the beneficial integration of watercourses into urban landscapes by creating an aesthetically pleasing public resource which will ultimately allow for the social and economic upliftment of communities adjacent to watercourses and wetlands;
- Provide an effective decision making tool for officials, developers and consultants by introducing an element of predictability with regards to

applications for development along watercourses/river corridors and adjacent to wetlands, and
- Promote sustainable development from engineering, environmental and socio-economic perspectives".

The objectives of the Floodplain and River Corridor Management Policy as well as Stormwater By-law is consistent with the requirement of the ICMA in terms of promoting risk averse decision making to water bodies from source to sea.

6. THE PUBLIC PARTICIPATION PROCESS

The establishment of CMLs have significant socio-economic implications, for both property owners as well as for communities. These may impact on property rights, value of property and real estate, opportunities to benefit from coastal resources through nodal coastal development, access to the coast, livelihoods etc. Consequentially engagement with stakeholders surrounding the position of CMLs is often emotionally charged and can be contentious. Considering this, and considering the complexity of coastal legislation, it is imperative that the stakeholder engagement process takes place over periods of time that allow and encourage dialogue and meaningful two-way communication between the implementing authority and Interested and Affected Parties (I&APs). This is key in allowing the process to determine the outcome.

Recognising the sensitivity required in this process of defining a CML, the City purposefully engaged with I&APs on an informal basis over an extended period of time prior to undertaking the formal PPP. The intent of these engagements was essentially to co-produce knowledge between the public and City officials surrounding coastal issues and how the concept of CMLs can be used to address these issues.

6.1 Informal stakeholder engagement

The City's informal stakeholder engagement process was initiated in 2007 and continues today. It consists of the following:

- Informal engagements with rate payer associations across the City of Cape Town;
- Presentations to ratepayer and interest groups focussing on:
    - Identifying pressures along the City's coastline
    - Identifying the impacts of these pressures and understanding how these impacts are experienced
    - Legal mandate of the City to establish coastal regulatory mechanisms, especially CMLs
    - The City's proposed methodology for determining the draft CML
    - Obtaining feedback from the public as key to shaping the City's methodology
- Site inspections and 'demonstrations' with local ward councillors

This process culminated in the delineation of the draft CML which was in turn presented to the officials of each of the City's planning districts in 2010 for further input and consideration. Following from this process the City entered the formal PPP process.

6.2 Formal stakeholder engagement

Following from the informal stakeholder engagement process and consultation with the planning districts, the City further refined its CML methodology and adjusted the position of the CML accordingly. In addition to this the City developed a supportive draft by-law as a means to regulate activities in the space between the HWM and the draft CML. Both the draft CML and the draft by-law were taken through an extensive PPP process. Publicising of the draft by-law in conjunction with the draft CML enabled the public to not only determine the position of the draft CML at an erf scale for the entire coastline, but it also enabled the public to gain an understanding of the regulatory context and 'meaning' of the draft CML thus making the PPP transparent and effective.

6.2.1 The City of Cape Town's Spatial Development Framework public participation process

The City's draft CML was incorporated into the CT:SDF, where it is termed the Coastal Urban Edge. The CT:SDF defines clear strategies and policy statements that will be used to guide the preparation of sector plans, lower-order spatial plans, detailed policies, guidelines and implementation plans and will also be used to assess development applications (CT:SDF, 2012).

The CT:SDF identifies the following key strategies applicable to the draft CML:

KEY STRATEGY 1:	Manage urban growth, and create a balance between urban development and environmental protection
Sub-strategy:	Encourage a more compact form of development
Policy Statement No. 23:	Contain the development footprint of the city, and protect natural, urban and heritage assets with development edges
Sub-strategy:	Appropriately manage urban development impacts on natural resources and critical biodiversity networks
Policy Statement No. 27:	Manage urban development along the coast in a sustainable and precautionary manner
KEY STRATEGY 3:	Build an inclusive, integrated and vibrant city
Sub-strategy:	Promote accessible, citywide destination places
Policy Statement No. 50:	Develop high quality, accessible destinations and public spaces in newly developed and neglected areas

These key strategies and policy statements are fundamental to the intents of the City's draft CML and were communicated extensively through the CT:SDF PPP (Annexure I)[14] from 2007 to 2010 (Figure 21).

[14] Sub-annexures to Annexure I are available upon request.

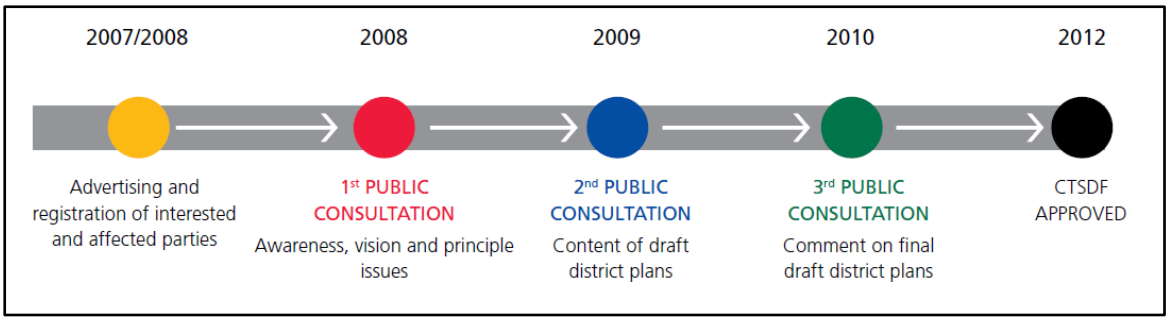

Figure 21: The City's Spatial Development Framework Public Participation Process timeline

6.2.2 Coastal by-law public participation process

The City's draft coastal by-law was developed with the intent of regulating the space between the HWM and the draft CML (further details on the City's by-law provided in Section 8.1.2). The PPP for the draft by-law was not only important for re-iterating the position of the proposed CML, but critically it provided an opportunity for I&APs to gain an understanding of the context of the CML and the potential implications the draft CML would have for the public. The publicising of the draft by-law also enabled the public to make informed comments on the City's approach to developing coastal regulations. Whilst the by-law received 97% support (Annexure J: Comments Response Report), the draft by-law is currently being revised to ensure better alignment with the City's Planning Development and Building Management Department's regulations. When these revisions are complete, the draft by-law will once again be taken through the PPP.

7. COMPARISONS WITH THE OVERBERG DISTRICT CML DELINEATION METHOD

The City was represented on the Steering Committee: Development of a Methodology for Defining and Adopting Coastal Development CML Lines for the Western Cape Province. This process was completed in May 2010. The City played an active role in this steering committee and made recommendations based on the City's approach towards defining CMLs as well as sharing lessons learnt from the City's own stakeholder engagement process. It is noted that whilst this process was initiated by the Development Facilitation Unit of the of the DEA&DP with the intent to determine the official method for CML delineation for the Western Cape Province, the subsequent CML methodology applied in ODM deviated from the proposed Western Cape Provincial methodology. It is also noted that the method applied in the ODM was undertaken with a view to further refine the Western Cape methodology. The City has drawn a comparison between the method and process adopted in Cape Town with the method and process applied in the ODM.

7.1 Unique areas require unique solutions

Overberg District Municipality and the Cape Town metro are vastly different in many respects, not to mention the extent to which the City's coastline has been developed, altered and in

some cases reclaimed. The highly altered and in many places 'fixed' coastline, as well as vastly differing socio-economic attributes brings unique challenges to the City. Naturally the City requires locally tailored responses to manage the city's unique coastal space. Even within the City's area of jurisdiction, the coastline varies significantly (i.e. from False Bay to the West Coast) not only in terms of physical attributes (including developed state) and oceanographic climate (such as bathymetry, swell shadow and wave set-up), but the socio-economic attributes along the city's coastline differ substantially as well.

Applying a standardised methodology across the Western Cape Province based on a set of generically determined and empirically orientated formulas does not empower municipalities to consider and factor in local nuances (both biophysical and socio-economic) that are critical in generating effective and pragmatic CMLs. For this reason, it is imperative that the determination of CMLs are rather guided by a set of regionally agreed upon principles which include that the CML delineation process is undertaken at a local level by practitioners who have local knowledge and that in instances where the CML is modelled, the position of the modelled portion of the CML is ground-truthed. The ground-truthing of remotely modelled CMLs is critical to ensure that the line on the map is in fact 'connected' to reality on the ground. These are key principles that the City has applied in the process of delineating its draft CML and which differ to the method applied in ODM.

7.2 Timescales and public engagement

The Public Participation Process (PPP) for the delineation of the CML in the ODM took place over a period of 6 months between 17th January 2011 and 22nd August 2011 (SSI, 2011). This consisted of two rounds of public engagement. Each round consisted of a total of 5 focus group meetings (in centrally located venues) as well as ad hoc telephonic, e-mail and face to face communication between Interested and Affected Parties (I&APs) during this period (SSI, 2011). The final round of public engagement followed a six-week comment period (SSI, 2011).

The process of defining a CML for ODM was largely viewed in a negative light by the I&APs which may have been partly attributed to the misinterpretation of information provided (SSI, 2011). According to R. Cox (pers. comm., 28 February 212) the perception by I&APs was that such an exercise was "out of the blue" and that this sudden enforcement was reflective of an authoritarian style of governance which in turn led to this negativity and in some respects hostility. Perception, whether informed or not, has the potential to derail delicate discussions surrounding the establishment of CMLs. This is especially true where perception may be shared collectively amongst the public. In acknowledgement of the "power of perception" and the need to engage with I&APs over meaningful periods of time, the City proactively initiated engagement on both an informal and formal level. This process commenced in 2007 and culminated in the successful adoption of the CT:SDF and overwhelming support of the by-law (Annexure J).

7.3 Modelling, local biophysical factors and ground truthing

The method employed in the OMD is largely dependent upon empirical modelling which has been applied at a broad scale from remote desktop analysis. The application of these models

over broad spatial areas is primarily a consequence of economies of scale: due to budget and time restrictions imposed on this project[15], the broad-scale application of models to determine physical risk is used as the most feasible means towards meeting budget and deadline requirements. Although such an approach reduces resources required, thereby enabling project consultants to meet deadlines and budget limitations, the budget and temporal limitations imposed also result in the exclusion of local biophysical factors in the determination of hazard areas. Local biophysical factors, such as bathymetry, swell shadow, wave refraction, beach profile and sub-straight have a significant influence on coastal erosion and wave run-up. It is therefore critical that these local elements are incorporated into the process of modelling and determining hazard areas.

The City, in its 5th and final phase of the SLRRA, fined tuned the original model developed in Phase 1 by collating data on local bio-physical attributes and factoring this data into the model (Section 4.2.5 and Annexure B). This enabled the City to identify a total of 19 vulnerable locations as identified in Tables 2, 3 and 4 and Figure 11). Further to this, the finer resolution study has enabled the City to disaggregate risk per location and thus more accurately determine the landward extent of hazard areas. Within an urbanised environment this is critical in the development of coastal planning and building development regulations.

7.4 Socio-economic dimensions, spatial planning and urban design

The ODM methodology makes recommendations as to the importance of aligning and integrating the CML with local spatial planning schemes, as the two should not be treated as mutually exclusive, but rather mutually dependant. Whilst the CML should be used as the primary informant to shape spatial planning schemes along the coastal fringe to promote risk averse coastal development, spatial planning schemes are also largely shaped by socio-economic priorities and at times may be in conflict to the objectives and 'position' of a CML. This is especially so considering the perception that coastal frontage property equates to economic wealth and gain as well as the potential the coast offers in addressing the legacy of the apartheid era through redistribution of resources. Whilst it is clear that the two mechanisms need to be aligned, the method in the ODM is largely silent on how this can be practically and measurably achieved. Again this may be attributed to the limitations under which the relevant consultants had to work.

Whilst the City has relied on the use of a model to determine hazard areas, the identification of hazard zones forms only one component of the broader process of defining the City's CML. The consideration of socio-economic and politicised factors requires stakeholder engagement over meaningful periods of time at a site specific scale. This is not only critical to ensure that the CML is workable, effective and practical, but that the CML is aligned to, and meets the needs of the local spatial planning schemes. Due to the socio-economic disparities and resulting priorities along the city's coastline, the City initiated the process of engaging with coastal communities and ward councillors at the outset of determining its draft CML in 2007. This local level engagement process was used to gain a sensitive understanding into the various socio-economic pressures and imperatives present along the coast. A key outcome of this process was the stark realisation of the lack of access to the coast (and associated

[15] This is by no means deliberate, but merely a product of the fiscal structures of governning bodies which are largely infleunced by budgetary expenditure being restricted to annual cycles.

opportunity) for previously disadvantaged communities. This led to the identification of key coastal nodal growth areas (Figure 6 and Annexure A refers) as a way to address this priority.

7.5 A management line and a limited development line

The method in ODM proposes the refinement of the two lines identified in the Western Cape Methodology. These two lines are represented as a management line and a limited or controlled development line. The City has identified a single line, where this line is supported by additional coastal regulatory mechanisms. The following sections underline the difference between the City's approach and the recommended lines in the ODM method.

7.5.1 Management line

The ODM method proposes that the management line "Demarcates the area seaward of current developments, and includes the area below the projected hazard zone where no development has taken place, and currently/immediately threatened properties in areas where development is already present in the risk zone. The zone is demarcated manually based on local knowledge of the development line and local planning intricacies" (SSI, 2011: 15).

The management line proposed in the ODM is essentially equivalent to the City's CML, the only difference being that in urban areas the position of the line still excludes (properties fall on the landward side of the draft CML) current/immediately threatened properties. As indicated in Section 3.3, this approach has been applied to facilitate efficiency and practicality through avoiding legal challenges of incorporating properties with development rights seaward of CMLs. The City's draft CML, as a general rule of thumb, skirts closer to the HWM in urban areas whilst in less developed rural areas, the City's draft CML moves further inland. It is the remaining un-developed spaces that require immediate and effective governance to prevent the existing coastal issues (property at risk from coastal erosion and storm surges) from recurring and increasing into the future.

7.5.2 Limited or controlled development line

The limited or controlled development line: "This area is equated to the Coastal Protection Zone within which coastal sensitivities need to be taken into account in all development decisions. This zone is determined based on local sensitivities such as long-term coastal processes risks, coastal vegetation, wetlands, estuaries and socio-cultural features. It includes developed areas where the projected erosion risk extends over existing developed areas but where realistic planning horizons mean that development approvals are unlikely to be refused" (SSI, 2011:15).

Much of Cape Town's coastline is in a highly developed state, a significant proportion of which is in close proximity to the HWM and in some cases on reclaimed land. The deliberate exclusion

of property with development rights from the draft CML in developed areas means that that there are numerous properties along the City's coastline that fall on the landward side of the CML, but which are still at risk from coastal erosion, storm surge events and general coastal processes. Governing property that is currently at risk is a complex process and requires more substantive regulatory responses than a second CML. In light of this, the City is in the process of developing a Coastal Overlay Zone as a land use mechanism that will become applicable to coastal hazard areas, both seaward and landward of the draft CML. Further detail on the mechanics of the Coastal Overlay Zone regulatory mechanism is provided in Section 8.1.1. The City is also mindful of not over-complicating the coastal space by creating multiple lines based on empirical modelling which are in effect theoretical lines.

8. PROCESS FORWARD: SUPPORTIVE PLANNING AND REGULATORY MECHANISMS FOR THE CITY'S CML

The City's draft CML requires supportive regulatory mechanisms to ensure the objectives of the CML are achieved. The City has delineated its draft CML and by-law as a priority to manage activities within remaining critical open spaces between the draft CML and HWM along the length of the city's coastline. In addition to this, the City requires more substantive land use regulatory mechanisms to effectively address the complex issue of existing property and infrastructure at risk to coastal hazards. The following sections provide an outline and intent of the key regulatory mechanisms the City is developing as a means to retain the value of the coast and reduce the City's risk profile. A report requesting support for the development of various policy and regulatory mechanisms was submitted to the City's Economic, Environment and Spatial Planning Directorate in 2011 (Annexure K). The report and the proposed regulatory mechanisms were supported (Annexure L).

8.1 Integrated Coastal Management Policy

The City has developed a draft Integrated Coastal Management Policy (Annexure M). This policy provides a strategic and overarching guideline that defines the rationale for the development of the City's coastal regulatory mechanisms. The policy also determines the vision, objectives and principles which will be used as a platform to promote consistent decision making across the City and to meet the principles of the ICMA. The policy will be supported by the City's Municipal Coastal Management Programme (MCMP) and which this MCMP will be operationalized through the Coastal Overlay Zone, Coastal By-law, the Coastal Economic and Spatial Development Plan and a range of Coastal Operational Management Protocols.

8.1.1 Coastal overlay zone: managing risk through existing land use management regulatory systems

The City's proposed by-law will focus on the regulation of activities between the HWM and the City's draft CML. Considering the extent to which the City's coastline has been developed,

and the close proximity of this development to the HWM, there is a significant amount of development that is at risk from coastal hazards, namely from storm surge, wind-blown sand, migrating river mouth induced coastal erosion and coastal flooding from estuaries. Managing existing properties and infrastructure currently at risk (especially where this risk is expected to increase into the future due to sea-level rise) through regulatory mechanisms requires sensitive negotiation with property owners due to existing land use rights. The City's ability to retrospectively address existing property that may be at risk through land use planning mechanisms will ultimately determine the City's effectiveness at managing risk posed by coastal hazards.

The City, in 2013, introduced a single unified zoning scheme (to replace its current fragmented zoning schemes) for its entire area of jurisdiction. Amongst others, the new scheme includes a mechanism to introduce overlay zones for specific purposes. Providing the opportunity to impose additional regulations in respect of specifically demarcated areas, or in respect of specific management issues across the city as a whole, this mechanism will provide the necessary flexibility to deal with diversity and uniqueness across the city and accommodate different objectives (such as those already spelled out in the CT:SDF). As such, developing a Coastal Overlay Zone is considered the most appropriate mechanism to manage and regulate land use and building development both seaward and landward of the City's draft CML, as it will be institutionalised as part of, and in a way that makes use of the City's already existing statutory development management systems and processes. Taking this approach will ensure alignment with and benefit from existing regulatory regimes and institutional systems and processes.

Forming part of the zoning scheme regulations (development management), an overlay zone is therefore a more detailed zoning mechanism that is applied in addition to the base zone of a property. The introduction of overlay zones is not an inevitable consequence of local area planning initiatives as identified through District SDPs, but rather a consequence of the critical need identified in the CT:SDF for targeted and specific development rules in addition to the underlying general base zone of land in the coastal area (CT:SDF, 2012). In the case of property or infrastructure at risk from coastal hazards, additional development rules in the overlay zone will be applied. Thus, overlay zones will be used as critical tool for strategic land use and building development not only to achieve a shared vision for Cape Town in terms of the CT:SDF, but also as a means to reduce the City's risk profile.

8.1.2 Draft Integrated Coastal Management By-law: regulating activities

The City has drafted a coastal by-law in terms of the provisions made in the Constitution of South Africa (Act 108 of 1996). Section 156(2) of the Constitution provides that a municipality may make and administer by-laws for the effective administration of the matters which it has the right to administer, and to exercise any power concerning a matter reasonably necessary for, or incidental to, the effective performance of its functions. The draft by-law will be applicable to the space between the City's draft CML and the HWM.

The City's draft coastal by-law is being developed with the intention to regulate a range of activities along the city's coastline. These activities stand to have significant negative coastal socio-economic and environmental impacts if they are not addressed. Key activities that the by-law focusses on include the following:

- Encroachment into coastal Public Open Space (to be addressed jointly by the overlay zone);
- Illegal structures (to be addressed jointly with the overlay zone);
- Harvesting of natural resources;
- Recreational activities: i.e. fireworks, use of jet skis etc.;
- Interference with coastal processes or the littoral active zone;
- Activities that impact on coastal biodiversity;
- Overnighting on beaches;
- The use of fires;
- Activities that may impact on public access to the coast;
- Pollution and littering;
- Commercial activities and trading, and
- Private functions.

The City views the development and implementation of the Coastal By-law as a critical local regulatory mechanism for a variety of reasons. In terms of promoting ICM, these include the following:

- To promote improved integration between the various City departments with respect to management of activities that have an impact on the coast;
- To equip the City to more effectively deal with illegal activities taking place along the City's coastline;
- To ease the administrative burden on both DEA and DEA&DP with respect to ensuring environmental compliance;
- To cover the gaps in existing coastal and environmental legislation in terms of coastal activities;
- Promote efficiency of legal proceedings;
- Promote consistency in decision making with respect to regulating coastal activities, and
- Achieve the objectives as set out in the ICMA.

8.1.3 Aligning the City's Draft Coastal By-law with ICMA

While the City's draft coastal by-law has been established in terms of the provisions made by the Constitution, the intention and objectives of the proposed coastal by-law are closely linked to the principles of ICMA and would be one of the City's most useful tools towards achieving the intent of the City's MCMP. As such, it is the City's intention to align the draft coastal by-law in accordance with the requirements of the ICMA and ultimately use the by-law to implement the MCMP.

The ICMA empowers municipalities to make by-laws for the effective administration of coastal access land (section 20(2)); empowers metropolitan municipalities to establish a coastal committee (section 42); to establish and implement a municipal coastal management programme (section 48); to make by-laws to implement, administer and enforce municipal coastal management programmes (section 50); and for municipalities to develop coastal planning schemes (section 56(3)(d)).

The City will continue with the development and implementation of its by-law in terms of the Constitution as an interim measure until such time that the City's MCMP is formalised. Upon formalisation of the City's MCMP, the by-law will be adjusted to meet the requirements of the ICMA.

8.2 Coastal Protection Zone and the Municipal Coastal Management Programme

Section 28 of the ICMA requires that the MEC determines a Coastal Protection Zone where the intent of the CPZ is to:

- "protect the ecological integrity, natural character and the economic, social and aesthetic value of coastal public property;
- Avoid increasing the effect or severity of natural hazards in the coastal zone;
- Protect people, property and economic activities from risk arising from dynamic coastal processes, including the risk of sea-level rise;
- maintain the natural functioning of the littoral active zone;
- maintain the productive capacity of the coastal zone by protecting the ecological integrity of the coastal environment; and
- make land near the sea shore available to organs of state and other authorised persons for –
    - Performing rescue operations; or
    - Temporarily depositing objects and materials washed up by the sea or tidal waters" (ICMA, 2008:36).

The Coastal Protection Zone defines the area to which the City's MCMP will be applied. The CPZ will be defined based on the landward most limit of the overlay zones (Figure 22).

Figure 22: An example of the spatial configuration of coastal planning mechanisms.

9. A CITY WITHOUT A CML?

Without a CML the status quo of ad hoc, ill informed, piece-meal and reactive decision making within the City will continue. This in turn will increase the City's risk profile. The City stresses the fact that this risk is not limited to physical damage that may arise from coastal dynamic processes or storm surges, but that risk created from inappropriate decision making will manifest in a variety of broader environmental and socio-economic forms.

In the absence of a formal CML, applications for *ad hoc* set-back line applications by the public will continue to increase. These *ad hoc* set-back lines are problematic for a number of reasons, namely:

- Applications for *ad hoc* set-back lines at an erf scale are inappropriate and disruptive towards the City's efforts in achieving consistency in determining its own CML;
- Acceptance of *ad hoc* set-back lines interrupts and reduces the potential for linear integration of the more desired application of continuous CMLs at broader scales;
- There are legal uncertainties surrounding these *ad hoc* set-back lines especially in terms of land use rights that may be affected in the future;
- *Ad hoc* set-back lines are issued by the competent authority without undertaking site inspections or ground truthing, and
- *Ad hoc* set-back lines are issued by the competent authority without conducting the necessary and relevant research.

Collectively these issues that arise as a consequence of not having a formal CML in place restricts the City's ability to achieve the objectives of the ICMA. In addition, the absence of a

formal CML increases the City's legislative burden which has cost implications from a staffing perspective, time delays and ultimately service delivery delays. At a grassroots level this translates into the gradual deterioration of the coast and with it the socio-economic opportunities the coast provides. The end result is that the coast is gradually being converted from an asset to a burden.

10. CONCLUSION

The City has undertaken a thorough process in delineating its draft CML. The process is being led by the City's Environmental Resource Management Department (ERMD) that has a combined experience of over 60 years in the field on Integrated Coastal Management. More importantly, officials within the ERMD have an intricate knowledge of the city's coastline which is critical in developing a grounded, effective and pragmatic CML.

The City's draft CML is embedded within the CT:SDF. This was undertaken with the knowledge that the effectiveness of a CML is largely dependent on how closely local planning schemes are aligned with the CML. Whilst on a map this alignment is represented by the City's urban edge in terms of the CT:SDF and the draft CML in terms of ICMA as a single line, from a City governance perspective this single line represents the synthesis of planning for socio-economic priorities into the future whilst simultaneously promoting a risk averse approach to coastal development. The investigation into the influence of local biophysical factors and the subsequent disaggregation of risk per location was critical to the process of defining risk areas and integrating these risk areas within the CT:SDF.

The alignment of the CT:SDF and the draft CML has not only reduced the scope for confusion within an already complex and dynamic space, but such an approach has achieved a measure of practicality. The fusion of the CT:SDF with the draft CML as one line has created clarity, not only for City officials in terms of guiding coastal planning and promoting risk averse and appropriate decisions, but it has also provided an appropriate platform of clarity for potential developers and investors. The formalisation of the City's draft CML will also streamline the Environmental Authorisation process. These key traits have resulted in overwhelming public support for the City's draft CML and supporting regulatory mechanisms.

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13. ANNEXURES