Benguela
CURRENT COMMISSION

Benguela Current Large Marine Ecosystem

Strategic Environmental Assessment

Scoping Report

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EXECUTIVE SUMMARY

Introduction to SEA and Scoping

The key mechanism for providing objective information to decision makers about the environmental consequences of developments is to undertake an Environmental Assessment (EA) of some kind. EAs are most commonly undertaken for single projects (when they are usually termed Environmental Impact Assessments - EIAs), but in this case there are and will be many projects within the BCLME as well as informal activities that are more difficult to quantify but have impacts upon society and the environment. It has become the norm in most jurisdictions that governments are committed to applying EAs to all levels of development planning.

To date, many project level EIAs have been conducted for large and small projects in all the BCLME countries. With some exceptions, these were done in isolation of each other. Consequently, the cumulative impacts of many developments being implemented at the same time or in sequence, are not known. Whilst the impacts of one project might be relatively small and contained, the cumulative impacts might be substantial and significant in the long term.

A known way to assess past, present and future cumulative impacts is to conduct a Strategic Environmental Assessment (SEA), which is "a formal process of systematic analysis of the social and environmental impacts of development policies, plans, programmes and other proposed strategic actions". Scoping is the process to determine the spatial and temporal boundaries and key issues to be addressed in the SEA. Its main purpose is to focus the SEA on a manageable number of important questions and to ensure that only key issues and reasonable alternatives are examined. The outcome of the scoping process is a Scoping Report (this document) that includes issues raised during the initial stakeholder consultations, and the draft terms of reference for the SEA.

Vision for the BCLME

The BCC's vision is "a Benguela Current Large Marine Ecosystem that is sustainably used and managed, conserved, protected and contributes to the wellbeing of the people of the region".

Its Mission is "to foster cooperation between the Republic of Angola, Republic of Namibia and Republic of South Africa and work towards an integrated, science-based and regional approach for the conservation, protection and sustainable use and management of the BCLME. To achieve this by facilitating the development and implementation of joint programmes of work".

Development scenarios relevant to the BCLME

Given that all three BCLME countries are showing relatively strong economic growth[1] (ranging from approximately 3-7% per annum), and that there is escalating retail and industrial activity in landlocked countries within the SADC Region, it is

[1] http://allafrica.com/stories/201204180985.html, accessed 17 September 2012

expected that urban developments along the coastline will increase rapidly, together with port expansions, shipping, offshore mining, industrialization projects, and ongoing exploration for and production of, oil and gas. Moreover, most of the larger river catchments will likely become more developed (e.g. dams, hydro schemes, irrigation, mining and urban developments), resulting in less and lower quality freshwater entering the ocean. South Africa and Namibia are expected to experience shortages of freshwater in the next decade, requiring more seawater desalination projects in the short to medium term.

It is expected that there will be modest growth in the mariculture, fisheries and tourism sectors. Continued investment in lifestyle developments will contribute to the growth of coastal towns and villages in all three BCLME countries.

The above broad scenario is unlikely to be dampened significantly even if the current global economic crisis continues, though growth may be slightly slower in the mining and industrial sectors. Conversely, an economic recovery in Europe and the USA, and faster growth in China and India, will certainly lead to more rapid development in various economic sectors in SADC countries.

Key environmental threats to the BCLME

There seems to be general consensus amongst specialists and members of the public that attended the scoping consultative meetings that all current threats to the BCLME are likely to increase in the future.

These include external threats:

- Climate change (influencing intertidal and marine life, environmental variability, sea-levels and sea surface temperature),
- Land degradation and deteriorating ecological functioning in catchments which support rivers that drain into the ocean (particularly the Orange, Kunene, Cuanza and Congo),
- Marine pollution from shipping.

And internal threats:

- Onshore, offshore and deep-sea mining activities together with inadequate fisheries management[2] and practices[3] are considered the most important internal threats to the environmental health of the BCLME.
- Marine Pollution - which is growing in complexity and intensity - is a major secondary threat linked to all sectors (but particularly coastal industrial activity, oil and gas exploration and production, shipping, seawater desalination and urban expansion).
- Inappropriate and/or poorly planned/managed coastal development, which alters coastal structures and processes and places escalating pressure on intertidal resources, freshwater, terrestrial biodiversity and air quality.
- The introduction and spread of alien invasive species,
- Inappropriate recreational activities (including angling, off road driving and cetacean watching boat trips).

[2] including inadequate transparency in setting of quotas and inadequate monitoring and policing

[3] Including high bycatch and illegal activities

The abovementioned threats are noted in various literature, produced for the BCLME project, published in peer-reviewed journals and available as unpublished internal reports.

From Scoping to SEA

It should be stressed that scoping provides only an initial assessment of the key issues and cumulative impacts, and, based on this, suggests draft Terms of Reference for the actual SEA. The SEA will build on the scoping phase.

ACKNOWLEDGMENTS

Steering Committee
Everyone who attended meetings
Those who commented on draft reports
Those who contributed information
The Scoping Team

Will be completed in early 2013 – once consultations are completed

ACRONYMS

A1B	One of six greenhouse gas emissions scenarios as presented in the IPCC's AR4 SRES. This scenario makes the following key assumptions: The future world will be one of very rapid economic growth, low population growth and rapid introduction of new and more efficient technology. Major underlying themes are economic and cultural convergence and capacity building, with a substantial reduction in regional differences in per capita income. In this world, people pursue personal wealth rather than environmental quality.
AR4	The IPCC's 4th assessment (most recent) report on global Climate Change completed in 2007.
BCC	Benguela Current Commission
BCLME	Benguela Current Large Marine Ecosystem
BID	Background Information Document
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCGT	Combined Cycle Gas Turbine
CD	Chart datum
CO_2	carbon dioxide
CTAN	Coastal Tourism Association of Namibia
DBCM	De Beers Consolidated Mines
DNP	Dorob National Park
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Programme
EMPR	Environmental Management Programme Report
EQO	Environmental Quality Objective
FAO	Food and Agriculture Organisation
GHG	Greenhouse Gas
GIS	Geographic Information System
GRN	Government of the Republic of Namibia
GSN	Geological Survey of Namibia
GTL	Gas to Liquids
H_2SO_4	sulphuric acid
HIV	Human Immunodeficiency Virus
IAP	Interested and Affected Party
IBA	Important Bird Area
ICCAT	International Commission for the Conservation of Atlantic Tuna
IDZ	Industrial Development Zone
IMO	International Maritime Organisation
IPCC	International Panel on Climate Change
IPP	Independent Power Producer
ISSCAAP	International Standard Statistical Classification of Aquatic Animals and Plants
IUCN	International Union for the Conservation of Nature
LA	Local authority

LPG	Liquid Petroleum Gas
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
Ml	Mega litres
MME	Ministry of Mines and Energy
MRA	Marine Resources Act
mt	million tonnes
mtpa	million tonnes per annum
MW	Mega Watt
N	nitrogen
NSRI	National Sea Rescue Institute (RSA)
NOx	nitrogen oxides
NP	National Park
PAH	Poly-aromatic hydrocarbon
PO_4	phosphate
RoRo	Roll on, roll off (ships)
RSA	Republic of South Africa
SADC	Southern African Development Community
SEA	Strategic Environmental Assessment
SEAFO	South-east Atlantic Fisheries Organisation
SLR	Sea Level Rise
SEMP	Strategic Environmental Management Plan
SO_2	sulphur dioxide
SRES	Special Report on Emissions Scenarios
SST	sea surface temperature
STD	Sexually Transmitted Disease
TAR	The IPCC's 3rd (2001) assessment report on Climate Change
tph	tonnes per hour
UNCBD	United Nations Convention on Biological Diversity
UNCLOS	United Nations Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change

GLOSSARY OF TERMS

Alternatives: A possible course of action in place of another that would meet the same purpose and need. An alternative can include other locations/sites, routes, layouts, processes, designs, schedules and/or inputs. The 'without project' alternative provides a benchmark against which to evaluate changes; development should result in net benefit to society and should avoid negative impacts.

Appreciable impact: impacts that are relatively large in number or amount or extent, and therefore big enough to be estimated or measured.

Assessment and evaluation of impacts: Using a systematic and explicit approach to determine the extent, duration and magnitude of impacts. The evaluation of impacts involves determining their potential significance.

Ecosystem approach: As advocated by the Convention on Biological Diversity (CBD), the ecosystem approach recognizes that people and their environment are part of the broader ecosystems on which they depend. Environmental management should therefore be implemented in an integrated way.

Environment: Includes all components of the environment, namely humans, flora, fauna, soil, climate, air, water, landscape, natural sites, material assets, cultural heritage and the interaction among these components.

Environmental assessment: A process that is used to identify, predict and assess the potential positive and negative impacts of a proposed development on the environment and to propose appropriate management actions that will enable the avoidance or minimisation of impacts.

> *Strategic Environmental Assessment (SEA):* The application of impact assessment to policies, plans, and programmes. Impact assessments at strategic level encourage an 'opportunities and constraints' type approach to development, where such things as natural resources and ecosystem services at landscape scale define the 'framework' within which development can take place and the types of development that could be sustained.
>
> *Environmental Impact Assessment (EIA)*: The application of impact assessment to a specific project. Typically, an EIA is carried out on a project that is already defined (i.e. in feasibility stage) and seldom considers landscape scale or cumulative impacts.
>
> *Transboundary Impact Assessment (TIA):* is an uncommon term but is used in some countries if a project is likely to have impacts on the environment in another country. However, most countries (and practitioners) recognise that any SEA or EIA will be broadened in scope if transboundary impacts are likely to occur.

Environmental Quality Objective. An EQO is typically a non-enforceable goal, which specifies a target for environmental quality, which - it is hoped - will be met in a particular environment. If EQOs are set by regulation, they are usually referred to as Environmental Quality Standards. In some cases, EQOs are a vague form of generally desirable objectives, but in other cases, they might be concrete quantitative measures. Wherever possible, they should be acceptable to all key stakeholders, quantifiable, verifiable and outcomes oriented. Implicit within all EQOs is a minimum management objective that any changes to the environment must be within acceptable limits and that pro-active intervention will be triggered by the responsible party to avoid unwanted changes that breach a specified threshold.

Impacts **Decision makers need to know** the direct, indirect and cumulative impacts of a proposed activity on the environment, if they are to take informed decisions in line with sustainable development.

> *Direct impacts* are those that take place at the same time and in the same space as the activity - e.g. clearing of natural vegetation for agriculture.
>
> *Indirect impacts* occur later in time or at a different place from the activity - e.g. the extraction of groundwater for irrigation leads to changes in the water table and affects distant water users.
>
> *Cumulative impacts* are the combined or additive effects on the environment of individual projects over time or of several projects in one geographical area. They may seem to be insignificant when seen in isolation, but collectively they have a significant effect. An example is a small mine that discharges effluent into a river, but in such small quantities that it is of no cause for concern. However, if there are many such mines in the catchment, all discharging small amounts of effluent into the river, then the combined impact could be significant.
>
> *Irreversible impact.* An impact that cannot be reversed in time. Some, but not all, irreversible impacts will lead to irreplaceable loss of biodiversity. An impact causes irreplaceable loss when it results in the loss of a resource without substitute. An impact leading to irreplaceable loss of biodiversity is, by definition, irreversible.

Inter-generational equity. Inter-generational equity implies that the current generation chooses a development path that does not jeopardize the ability of future generations to achieve similar or better development options.

Issue. A context-specific question that asks "what, or how severe, will the impact of some activity/ aspect of the development be on some element of the environment?"

Monitoring. Actions taken to observe, take samples or measure specific variables in order to track changes, measure performance of compliance, and/or detect problems. The objective of monitoring should always be to improve management.

Notification. Notification is the formal process of States officially notifying other States when they are planning to carry out activities that may cause significant adverse effects upon other States.

Offset. An offset replaces or provides ‘like for like or better’ substitutes for residual negative impacts on the environment. Such offsets could include formal commitment to managing substitute areas of comparable or greater value for conservation, entering into a secure and permanent conservation agreement with the conservation authority, setting aside protected natural areas, establishing a trust fund for conservation, thereby enabling land acquisition and/or management, etc. Offsets focus on areas of recognised value to conservation and on ensuring the persistence of landscape-scale processes.

Opportunity cost. The lost opportunities that might result from the implementation of a certain alternative. For example, a mine in a national park will likely reduce the tourism potential of the area. Therefore there are opportunity costs to the building of the mine, namely the reduction of actual and potential touristic activity.

Precautionary Principle. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Public. Means one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organizations or groups.

Risk. Likelihood of occurrence of an impact that will cause significant environmental degradation.

Scenario. A description of plausible future environmental or operating conditions that could influence the nature, extent, duration, magnitude/intensity, probability and significance of an impact occurring (e.g. concentration of sulphur dioxide emissions during normal operations vs. during upset conditions; dispersion of atmospheric pollutants during normal wind conditions vs. during presence of an inversion layer).

Scoping. The process to determine the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in an environmental assessment. Its main purpose is to focus an EA on a manageable number of important questions and to ensure that only key issues and reasonable alternatives are examined. The outcome of the scoping process is a Scoping Report that includes issues raised during the process, appropriate responses and, where required, terms of reference for specialist studies.

Screening. A decision-making process to determine whether or not a development proposal requires environmental assessment, and if so, what level of assessment is appropriate. Screening is usually conducted by an environmental authority or financing institution.

Significance. A term used to determine how severe an impact would be, taking into account objective or scientific data as well as societal values.

Significance thresholds. A significance threshold is the level at which impacts would change a significance rating. These thresholds are often linked to current societal and/or community values which determine what would be acceptable or unacceptable to society and/or affected communities, and may be expressed in the form of legal standards or requirements, as objectives or targets for conservation, protocols, guidelines, or conservation status of species or ecosystems. These thresholds may include a range of 'warning' signs of increasing intensity of ecosystem degradation that trigger action to halt or reverse that degradation, and 'danger' signs indicating that there is unacceptable deterioration and that radical steps need to be taken.

Trigger. A particular characteristic of either the receiving environment or the proposed project which indicates that there is likely to be an issue and/or potentially significant impact associated with that proposed development that may require specialist input.

Uncertainty. The inherent unpredictability of response of the environment to an impact, the lack of knowledge and/or understanding of cause-effect-impact relationships between the activity and the environment, and/or gaps in information that do not allow confidence in predictions of impacts. Uncertainty is inevitably linked to an unprecedented activity (i.e. something that has not been done before). Also, it is common in complex ecosystems (e.g. river estuary).

Vulnerable communities. Those communities who rely heavily on those ecosystem goods and/or services likely to be affected (e.g. communities where livelihoods are based on the harvest of natural resources) or who live in dynamic, sensitive or harsh ecosystems, where extreme conditions (e.g. drought, floods, earthquakes, landslides) make them particularly vulnerable to additional negative impacts.

Important Bird Area. an area recognized as being globally important habitat for the conservation of bird populations.

Policy. A general course of action or proposed overall direction that a government is or
will be pursuing and that guides ongoing decision making.

Plan. A purposeful forward looking strategy or design, often with coordinated priorities, options and measures that elaborate and implement policy.

Programme. A coherent, organised agenda or schedule of commitments, proposals, instruments and/or activities that elaborate and implement policy.

Ramsar Convention. an international treaty that commits its member countries to maintain the ecological character of their Wetlands of International Importance.

1. INTRODUCTION

1.1. The need for the Benguela Current Large Marine Ecosystem SEA

Increasing international concern has been expressed over the deteriorating condition of global coastal ecosystems that produce most of the world's living marine resources. With few exceptions, these are subjected to increasing stress from toxic effluents, over fishing, habitat degradation, excessive nutrient loading, harmful algal blooms, emergent diseases, fallout from aerosol contaminants and episodic losses of living marine resources from pollution effects and overexploitation.

The Terms of Reference (ToRs) for this SEA Scoping study state that, in June 1992, the following declaration for action linked to the United Nations Conference on Environment and Development (UNCED), was adopted by the majority of coastal nations, which thus undertake to:

- prevent, reduce and control degradation of the marine environment so as to maintain and improve its life -support and productive capacities;
- develop and increase the potential of marine living resources to meet human nutritional needs as well as social, economic and development goals; and
- promote the integrated management and sustainable development of coastal areas and the marine environment.

The ToRs state further that to achieve the UNCED objectives of an ecological framework for management, the Large Marine Ecosystem (LME) concept was proposed and adopted. An essential component of such a management regime is the inclusion of a scientifically based strategy to monitor and assess the changing states and health of the ecosystems by tracking key biological and environmental parameters. This management system includes regulatory, institutional and decision-making aspects as well as the scientific information on conditions, contaminants and resources at risk within the geographic extent of the ecosystem.

As noted in the ToRs, the resources of the Benguela Current Large Marine Ecosystem (BCLME) have played an important economic role in South Africa, Namibia and Angola, and will continue to do so in the future. Commercial fisheries are an important industry in South Africa and Namibia, and in Angola artisanal fisheries provide a living for coastal populations in addition to the commercial fisheries. Marine diamond production has been the largest contributor to GDP in Namibia for years, while the importance of the offshore oilfields for Angola is significant. In all three BCLME States, coastal tourism and demand for lifestyle opportunities along the coast, is escalating, resulting in more coastal land being converted to housing and related developments.

There are a number of other development activities throughout the BCLME with environmental and social implications, which need to be considered. These include conservation and tourism (assumed to have positive impacts), wastewater management, desalination, major infrastructure development (e.g. harbours, waterfronts, town expansion, marine infrastructure and industrial parks), and marine transport. Inland from the coast, land use and developments in river catchments will also likely have impacts on the coastal and marine environments, particularly dams, weirs, hydro schemes, mining and mega irrigation projects.

The land area adjacent to the BCLME is home to one of the world's largest trans-boundary protected areas, starting with the Iona National Park of Angola in the north, followed southwards by the Skeleton Coast, Dorob, Namib-Naukluft and Sperrgebiet National Parks in Namibia, and ending with the Richtersveld National Park of South Africa in the south, covering almost the entire Namib Desert. Fragile environments might be at risk from various activities. In particular, the sensitive ecology and landscape of this much visited and appreciated coastline and desert underpins an important tourism industry, and can easily be compromised by negative impacts of various types of development.

Sink et al (2011) states that a high percentage of marine and coastal habitat types have no protection and many are threatened. In South Africa alone, 40% of all marine and coastal habitat types, including many along the Namaqualand and the southwestern Cape coastline have no protection status at all. Offshore, the BCLME supports several of the most threatened marine habitat types in South Africa (ibid).

The most vulnerable coastal habitat in the BCLME include:-

- The intertidal zones – especially near to development nodes where large numbers of people use the coast for recreation, off-road driving and/or the informal collection of edible intertidal organisms.
- Mangrove swamps (in Angola), which are biodiversity rich and highly vulnerable to over-exploitation. Healthy mangrove forests have a huge value for coastal communities that derive their livelihoods from them – they provide wood and diverse and abundant food – but are under protected and easily over utilised (BCLME, circa 2008).
- The rocky offshore islands (13 in Namibian waters[4] and 17 in South Africa[5]) that provide natural sanctuaries for breeding and roosting seabirds and seals and a large number of which are considered IBAs (Important Bird Areas) – see footnotes. The majority of the global populations of six seabird species breed on these offshore islands (the African Penguin; Cape Gannet; Cape Cormorant; Bank Cormorant; Crowned Cormorant; Hartlaub's Gulls) but other species (including the African Black Oystercatcher) breed on these islands too. One offshore island for Angola (Ilha dos Tigres) is mentioned in the literature (in the context of providing a haven for breeding birds (Kemper et al 2007).
- The perennial river mouths and their accompanying estuaries, lagoons, pans, mudflats and other wetlands. These sites attract large numbers of birds re and – in the case of the larger rivers (like the Orange, Olifants and Berg) – are believed to be important sites for fish breeding and shelter.

Only Namibia and South Africa are signatories to the International Convention on Wetlands (www.ramsar.org). Through this convention the following coastal wetlands within the BCLME have been granted Ramsar status and are thus considered wetlands of extreme international importance:-

[4] The most notable of these include : Halifax Island, the Long Islands, Possession, Albatross Rock, Bird, Mercury, Pomona, Plum pudding and Sinclair Islands. The islands are uninhabited, waterless and home to numerous seabirds and Cape fur seals.

[5] The most notable of which include Bird island, Robben Island, Dassen Island , Dyer Island, Jutten Island, St Croix and the Prince Edward islands.

- The Walvis Bay lagoon an IBA of significant importance consisting of intertidal areas, mudflats and sandbars, which serve as feeding and roosting areas. The site supports 48 species[6] - many of which are waders and /or migratory - and up to 156 000 birds in summer (Wearne and Underhill 2005). Conservation issues include reduction of intertidal habitat, the close proximity to the town and port of Walvis Bay.
- Sandwich Harbour, which falls within Namibia's Namib-Naukluft Park. Is comprised of two distinct wetlands and associated mudflats which support large numbers of wading birds.. One is aquifer-fed, and is slowly disappearing due to natural causes. The second, under tidal influence, consists of mudflats and raised shingle bars.
- The transboundary Orange River Mouth. A linear floodplain of islands and sand bars through an arid region. The site provides habitat for a variety of endemic plants and, in terms of bird numbers supported during the summer, is the sixth richest wetland in southern Africa. Environmental threats include diamond mining, irrigation, large-scale water abstraction and nearby urban development.
- Langebaan. A large (6 000 ha) shallow marine lagoon includes islands, reedbeds, sand flats, salt marshes and dwarf shrubland. The lagoon is an important nursery area for a number of fish species and supports a diverse and ecologically important algal and shoreline biota (www.ramsar). Important for wading and sea birds including the largest colony of gulls in South Africa. Threats include agriculture and a small commercial fishery.
- Prince Edward Islands which include the sub-Antarctic Marion Island and Prince Edward Island. They are protected natural habitats and do not support any consumptive or exploitative activities. Significant wetland formations include non-forested peat lands (swamps and bogs), intermittent streams, waterfalls, freshwater ponds, crater lakes, rocky marine shores, kelp beds, sea cliffs and sand shores. The islands host numerous[7] breeding seabirds (e.g. the vulnerable Wandering Albatrosses and White-chinned Petrel and the endangered Sooty Albatross and Yellow-nosed Albatross). Three penguin species breed and moult on the rocky areas around the coastline: the King Penguin, Macaroni Penguin and Eastern Rockhopper Penguin. Illegal, unreported and unregulated fishing for Patagonian Toothfish in the surrounding waters has caused reduction in fish stock and high levels of incidental mortality of seabirds (www.ramsar.com).
- Verlorenvlei is one of the largest lakes (and one of South Africa's few coastal freshwater lakes), with associated scrub, shrubland, dune systems, marshland and reedbeds representing a transition zone between two plant communities. The site is an important feeding area for rare pelicans and fish, for moulting and breeding waders and other birds. During dry periods, large numbers of flamingos gather. Threats include water pumped for irrigation purposes, and the marshland is used for cattle grazing.
- De Hoop Vlei is part of a provincial Nature Reserve. It is a coastal lake of seasonally varying levels of water and salinity, formed when dunes blocked the course of the Sout River. Important for numerous species of wintering and staging waterbirds. A research programme is under way to monitor the impact of the military test range on the ecology of the reserve and surrounding area

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[6] The most common include Curlew Sandpiper, Sanderling ,Little Stint ,Chestnut-banded Plover, White-fronted Plover, Pied Avocet, Ruddy Turnstone and Grey Plover.

[7] The website http://www.africanbirdclub.org/countries/SouthAfrica/ibas.html states that these islands support some 2.5 million breeding seabirds

(www.ramsar.com). The native turtle, common in the 1960s, has since become rare.

- De Mond (Heuningnes Estuary). A Nature Reserve which supports an estuary, dune system, and saltmarsh where shifting dunes are isolating the estuary. Important as wintering and feeding area for several species of breeding birds and locally migrant waterbirds. Provides an important habitat for various reptiles, notable crustaceans, and the seahorse (*Hippocampus* sp).

In recognition of the importance of the BCLME, and the need to manage and utilize its resources sustainably for the benefit of current and future generations, the three countries requested the Global Environmental Facility (GEF) to fund a comprehensive project on the BCLME. The resulting BCLME Programme was initiated and ran initially for five years (2002 to 2006), before being extended. It was designed to address trans-boundary problems in three key areas of activity: the sustainable management and utilisation of living resources; the assessment of environmental variability, ecosystem impacts and improvement of predictability; maintenance of ecosystem health and management of pollution.

The Benguela Current Commission (BCC) was subsequently established and it has prioritised the commissioning of this SEA in an attempt to understand the main cumulative impacts of concern in the BCLME, and to provide guidance to future decision-making.

1.2. What is SEA and Scoping?

The key mechanism for providing objective information to decision makers about the environmental consequences of developments is to undertake an Environmental Assessment of some kind. EAs are most commonly undertaken for single projects (when they are usually termed EIAs), but in this case there are and will be many projects (e.g. shipping, port development, coastal township expansions, marine mining, extraction of living marine resources, oil and gas production), within the BCLME, and many of these might differ from each other (e.g. land use, water use, waste generation, number of employees, project life). Moreover, there are many other, often-informal activities in the area that are more difficult to quantify but have impacts upon society and the environment (e.g. informal settlements, artisanal fishing).

To date, many project-level EIAs have been conducted for large and small projects in all the BCLME countries. With some exceptions, these were done in isolation of each other. In many cases, projects have gone ahead without any EIAs being done. Consequently, the cumulative impacts of many developments being implemented at the same time or in sequence are not known. Whilst the impacts of one project might be relatively small and contained, the cumulative impacts might be substantial and significant in the long term.

The internationally recognised way to assess past, present and future cumulative impacts is to conduct a SEA, which is "a formal process of systematic analysis of the social and environmental impacts of development policies, plans, programmes and other proposed strategic actions. This process extends the aims and principles of EIA upstream in the decision making process, beyond the project level and when major alternatives are still open" (UNEP 2002). Thus, the greatest strength of SEA is that it allows us to really consider alternatives and assess the "big picture".

Scoping is the process to determine the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in the SEA. Its main purpose is to focus the SEA on a manageable number of important questions and to ensure that only key issues and reasonable alternatives are examined. The outcome of the scoping process is a Scoping Report (this document) that includes issues raised during consultations, and the draft terms of reference for the SEA.

1.4. Assumptions and limitations

In spite of the considerable volume of research and monitoring conducted in the BCLME over the past decades, data for many aspects of the system are inadequate, as there are components of the marine environment that have never been studied. Obtaining a comprehensive knowledge base for all aspects of the BCLME will take many more decades. For the purposes of Scoping, there is no option other than to rely on existing knowledge. However, it may be necessary at the full SEA stage to undertake additional research in order to fill critical knowledge gaps and improve our understanding of the risks of various current and planned developments or industries.

Perhaps the greatest challenge this SEA will face is the genuine consideration of alternatives, and thus the opportunity to fundamentally change the way the respective governments, local authorities and private-sector developers make investment and development decisions. Countries may continue with 'business as usual', pursuing their sector policies, plans and programmes in order to achieve maximum benefit for their economies, and socio-political objectives. However, the SEA needs to encourage the three governments to understand:

- The localized and cumulative impacts of the policies, plans, programmes and projects they are/wish to pursue;
- The extent to which their choices present opportunity costs or synergies; and
- The consequences of decisions taken today, on future generations.

Also, the SEA must provide succinct and practical "best practice" guidance on how to avoid or minimize negative impacts and how to enhance benefits. In this way, the SEA should be a valuable decision-making aid and a mechanism for civil society and other stakeholders to expect more carefully considered decision-making by those in positions of power. In this way, the SEA should be a valuable addition to whatever governance and technical tools the respective countries already have.

Another key assumption is that the SEA will encourage the three countries to co-invest and commit to implementing an outcomes-based Strategic Environmental Management Plan (SEMP), and undertaking focused monitoring and reporting. Based on current levels of cooperation, one assumes that the SEMP will be implemented in an effective manner. One way of doing this would be for the three countries to develop (in consultation with each other) a Coastal and Marine Policy that promotes the sustainable development of the BCLME.

1.5. SEA implementation context

To follow – needs clarification from the BCC, on what legal mechanisms are available to encourage/enforce implementation/adherence of the SEA.

2. SCOPING METHODOLOGY

For this Scoping Process, the BCC required the consultants[8] to follow a participatory process, to ensure that relevant stakeholders were aware of the initiative and able to participate in the early thinking. Also, it was necessary to engage the BCC Steering Committee early to ensure that expectations, procedures and administrative requirements were properly aligned from the onset. Most government institutions from the three countries were well represented on the Steering Committee (approximately at Director´s level).

Establishing the context was an important initial phase of the SEA scoping, to enable the team to set the framework for all subsequent SEA related issues. In that phase relevant stakeholders were invited to meetings (see below for elaboration).

The TORs specified that the scoping process should establish:

- the content of the SEA,
- the geographical focus (BCLME),
- the time frame (long-term assessment).

The SEA Scoping Team was to be kept small and efficient, but the team that will conduct the SEA itself will of necessity be substantially larger, encompassing a greater diversity of expertise. The ToRs for the SEA (see Chapter 6) will be specific in this regard. The required deliverables for the scoping phase were specified as follows:

- Scoping Report and ToRs for the SEA (delivered in December but stakeholders will have until end-January to comment, allowing February 2013 for revision and compilation of final report and TORs[9]);
- Stakeholder list;
- Record of Meetings;
- Bibliography.

An overview of the process followed during the Scoping Phase is illustrated and explained below:

[8] BCC appointed the Southern African Institute for Environmental Assessment

[9] These were the original dates, but deadlines changed by mutual agreement because of the Angolan elections, which caused a delay in stakeholder consultations in Angola.

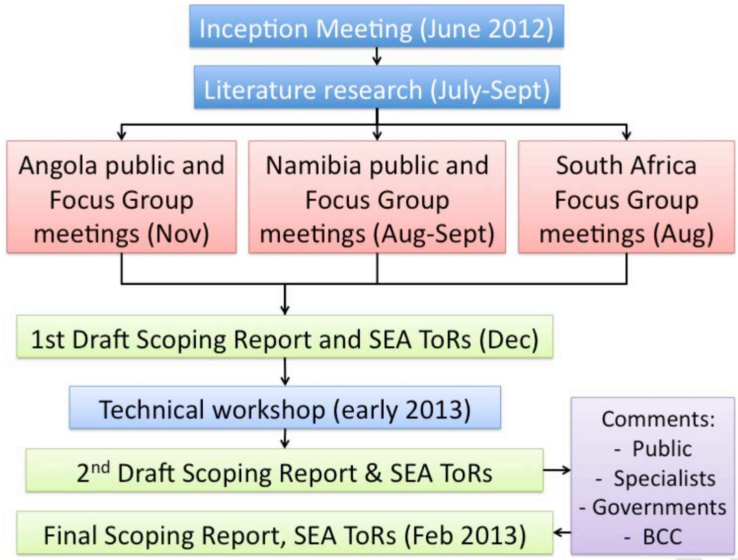

Figure 2.1: Scoping process

An inception meeting was held in Windhoek on 27 June 2012, marking the start of the process. At this meeting, agreement was reached on how further consultations should be done. At all venues (except Cape Town, where no public meeting was held), an open-door public meeting was held, followed by meetings with identified stakeholder groups in the following days, including government agencies (local, regional and national), commerce and industry, conservation, fisheries, tourism and port management experts. In most cases, representatives from the BCC attended the meetings, and provided additional information to stakeholders about the need for the SEA and how it could be implemented.

The meetings were advertised in local media as well as by email to targeted stakeholders, but attendance was disappointing overall. This is attributed to the fact that people are generally more interested in local issues (that affect them directly) than strategic-level issues. Meetings were held in Cape Town, Lüderitz, Swakopmund, Windhoek, Benguela, Luanda and Cabinda, during the period August-November 2012.

The main purpose of the meetings was to:

- Inform people about the SEA and discuss how they could be involved during scoping and later on, during the SEA;
- Hear people's concerns regarding current and future impacts on the BCLME;
- Obtain people's suggestions about what research/investigations that they think needs to be done by the SEA team so that adequate information will be available for strategic decision-making; and
- Obtain advice on where pertinent literature or additional expert advice could be obtained.

Whilst meetings were generally poorly attended, discussions at all venues were substantial, very informative and generated much interest in the SEA. Our sense though is that the SEA team will have to put in a major effort to attract much greater participation of the general public in the SEA phase.

The gathering and review of pertinent literature was an ongoing activity throughout the Scoping process. In addition to documents generated during the original BCLME project, the team obtained published and unpublished reports from various sources. These have been referred to (and acknowledged) as appropriate, and listed in Appendix I of this document.

2.5. Stakeholder opinions

The views of stakeholders have been summarised under the following sub-headings that emerged as key areas of concern in the three countries. Whilst there were subtle differences in the concerns raised in the three countries, it was decided to combine stakeholder views rather than present a fragmented response.

Fisheries

The greatest concern expressed by stakeholders from the fishing sector in Angola, South Africa and Namibia is that seabed mining, industrialization and exclusion zones created by the oil and gas industry, is and will increasingly be a major threat to commercial fishing in the near to medium future. According to participants at the Cabinda meeting, fishing communities in Cabinda are already apparently suffering because of restrictions imposed because of oil exploration and production activities.

In South Africa, the creation of marine parks was seen by some members of the fishing sector, as a threat to fishing. Others in the meeting pointed out that marine parks should be seen as an opportunity – one that can allow certain fish stocks to recover. Participants at the Luanda meeting expressed disappointment that Angola has no marine protected areas, arguing that some are needed to properly look after the country's marine resources.

There was denial amongst a number of fisheries representatives – both in Namibia and South Africa, that the extractive marine living resources industries have had any negative impacts on the BCLME – the predominant opinion amongst them is that the fisheries sector, as currently practised, is responsible and sustainable. Private communications with resource persons within this sector (both government and fishing companies) revealed contradictory opinions, with some expressing deep concern that 'money and greed are driving the industry', rather than science and good governance. One person described Namibia's fisheries as 'one of the dirtiest in the world' because of the high number of seabirds that are killed as 'bycatch'. Evidently, this problem is far less serious in South African waters because bycatch avoidance measures have apparently been more successfully implemented. In all three Angolan meetings, participants noted the fact that there are inadequate controls in place to manage both commercial and artisanal fisheries, which are thought to be resulting in a number of negative impacts. These include high bycatch, wastage, pollution (waste from fish processing being deposited on the seashore) and in some areas, destructive sweeping of the sea floor until 'it looks like a desert". Stakeholders in Benguela report having noticed a drastic decline in catches per unit effort, attributing this to over-fishing by foreign vessels and local fishermen.

The impacts of following a single-species management approach were discussed in the Swakopmund and Cape Town meetings. The Namibian Government has sometimes overridden scientific advice on Total Allowable Catches (TAC's), and the resultant overfishing was mentioned by fisheries scientists as an issue of concern.

South African representatives from the DEA also brought attention to the fact that there is inadequate transparency within the fisheries sector and that decisions made regarding fisheries management are not always made public.

Fisheries scientists in South Africa expressed concerns about the state of the west coast lobster stocks as well as most other fish stocks within the BCLME – due to the combination of pollution, overharvesting, poaching and highly variable climatic conditions.

The extent and impacts of poaching throughout the BCLME are largely unknown. However, IUU (illegal and unreported or under reported fishing) appears to be a problem in some fisheries. It was suggested that this issue receive more attention in the SEA. Concerns regarding inadequate policing /enforcement of maritime laws within the BCLME (especially beyond sovereignty zones) was expressed in both South Africa and Namibia.

Governance issues

Attendees at the stakeholder meetings mentioned policy conflicts and a lack of co-ordination/synergy between the different sectors within each country and between the three different countries. They emphasised a need to harmonise /standardize the laws and policies within the three countries regarding law enforcement, pollution control within the fisheries, mining and tourism sectors. Participants at the Benguela meeting specifically noted the fact that 'there seems to be less cooperation among the various sectors that operate at the coastal zone" and that "the province is not working in a holistic way".

In particular, it was noted with concern that some activities are 'soft targets' when it comes to insistence for rigorous EIAs, but in other cases, projects go ahead with poor or no EIAs at all. Very often, governments are guilty of expecting 'best practice' from private sector entrepreneurs, whilst they (or developers who are politically connected) often circumvent their own policies and laws. Stakeholders in Cabinda are especially concerned about poor EIA practice, specifically that local communities are hardly ever consulted before projects are implemented and that communication channels with developers are poor. The SEA needs to examine the issue of consistency, and encourage better governance in the application of environmental safeguard tools.

Marine transportation and ports

At the Swakopmund meetings an authority on port development mentioned that the SEA will need to consider SADC's 'Vision of connectivity' via various corridors that enhance transport. These corridors are likely to have major environmental implications which are not being adequately addressed at project level, and not even at national level.

The growth in on- and offshore ship repairs in Namibia and Angola was mentioned as a concern in the Swakopmund meetings. Stakeholders questioned whether these activities are being monitored. The impact of increasing shipping activity on cetaceans (mostly toothed whales) throughout the BCLME was expressed as a concern in the Namibian and South African meetings.

Desalination plants

Stakeholders in Namibia and South Africa brought attention to the fact that many more desalination plants are expected in the near and medium term and that the full impacts of these plants do not seem to be well understood and documented. It appears as though a number of smaller plants in South Africa were constructed during an 'emergency drought situation', meaning they could go ahead without an EIA (e.g. at Mossel Bay). It also appears that most are operating illegally as they do not have the necessary wastewater discharge permits.

The general feeling amongst concerned members of the public in both countries is that decision-makers underestimate the negative impacts of desalination, and that not enough effort is going into water recycling/reclamation, which is done efficiently in many cities (e.g. Windhoek), and is known to be far cheaper and environmentally more acceptable than desalination.

Coastal zone urban and industrial development

Most people consulted during the Scoping process expect the coastal towns to continue growing, especially those in Angola. Industrial development in the vicinity of Swakopmund is a major cause for concern amongst conservation groups, concerned citizens and people involved in the tourism sector. Individuals from the Fisheries sector expressed concern that these developments are in direct conflict with the sustainable development of the BCLME, the future of the fishing industry and the development of mariculture along the coast. In many cases, township expansions and industrial projects are taking place too close to the shoreline, making them vulnerable to sea-level rise. In the face of more intense storms (possibly linked to climate change), the response is inevitably coastal armouring (replacing stretches of natural coastlines with engineered structures). This usually changes water and sediment movements and the ocean's energy characteristics at local scale. Also, increased proximity of industrial properties to the sea increases pollution risks.

Stakeholders in Cabinda expressed concern about deteriorating water quality in their area, attributing this mainly to the oil industry, but also poor waste management in general. They feel there is a need for establishing limits to shoreline development, as coastal communities are being displaced and the coast is increasingly vulnerable to erosion. People at the Luanda meeting expressed concern that sewerage from the various town and cities is often discharged directly into the ocean, whilst the discharge of ballast water, oil, refuse and other waste from ships anchoring in harbours such as Luanda, Lobito, Tombwa and Namibe is becoming a serious problem.

The public seems somewhat less vocal about other new projects, such as the proposed Cape Fria harbour in the wilderness area of the Skeleton Coast National Park, but clearly the cumulative impacts of two new harbours[10] along Namibia's central-northern coast needs to be assessed in the SEA.

[10] Proposed Cape Fria and just north of Swakopmund (feasibility studies underway)

Representatives from all the local authorities present at the consultative meetings seemed acutely aware of the continued expansion of their towns, and cited difficulty in providing services to an increasing population, without the concomitant increase in taxes. They agreed that there will be many challenges regarding environmental health and sustainability of service provision. There were conflicting views from representatives of the various local authorities, with the majority seeing escalating development as a boom to the local economy and thus their tax base, which is generally regarded as inadequate.

Seabed and coastal mining

Growth in coastal, offshore and deep-sea mining is expected within all three countries of the BCLME – especially in Namibia and South Africa.

Offshore mining for phosphates in Namibian waters is the cause of considerable concern to local environmental groups, marine scientists and commercial fisheries. These groups question the fact that seabed phosphate mining in Australia is not permitted but that an Australian company has been grated rights to mine this mineral off the coast of Namibia. They believe that this is a strong case for the application of the Precautionary Principle – that a moratorium should be placed on seabed mining until such time that the impacts of this activity are better understood. Concerns were also voiced regarding phosphate 'rinsing' on land – creating another source of pollution, which will end up in the sea.

In addition to the case mentioned above, there are a number of other phosphate exploration licences off Namibia's coast, and some in South African waters as well. It is argued by those opposed to this type of mining, that, whilst the impacts of one operation may be small, the cumulative impacts of seabed phosphate mining in different localities at the same time, could have significant impacts on marine biodiversity and fisheries. It was suggested that assessing the cumulative impacts of seabed phosphate mining should be one of the priority tasks of the SEA.

Tourism/ non-extractive recreational activities

Tourism is likely to continue to increase at all suitable sites, with the fastest growth likely along the Angolan coast (a relatively unknown tourism destination). The general consensus is that Africa's west coast is undervalued as a tourism destination, with much room for expansion.

However, as noted earlier, stakeholders expressed concern about the conflict that will arise between this sector and the trend of increasing industrial development along the coast, much of which detracts from the desired 'sense of place' that is conducive to attracting visitors.

Concerns were voiced that dolphin, seal and whale watching tourism has become oversubscribed (especially in South Africa and Namibia), and could be having a detrimental effect on these marine mammals. Researchers from the Namibian Dolphin Project reported that bottle-nosed dolphins appear to be moving away from the Walvis Bay area (towards Lüderitz), possibly because of increased disturbance from tourism, but on the other hand, whale numbers are increasing. Cape Town representatives at the meetings report that southern right whales are increasing in the area around the Agulhas bank. In South Africa there are fears that shark watching activities (and film making) have had some impact on shark distribution and behaviour. It was suggested that sharks are more prevalent now in False Bay, and that conflicts between bathers/surfers and sharks may increase. However, insufficient research has been carried out to make any definitive conclusions around shark-human interactions.

Mariculture

Stakeholders from the Namibian fishing industry (private sector and government) are concerned that there is insufficient support for, and investment in mariculture, and that future opportunities in this sector will be undermined if more industrial development of the coastal zone is allowed. A compounding factor is that most mariculture projects in the BCLME are in close proximity to existing towns and ports, because of the need for calm waters (in an otherwise high-energy, exposed coastline), power and other infrastructure. It was pointed out that there are limited places suitable for mariculture, and that these need to be protected if this sector is to achieve its potential.

Knowledge and awareness gaps

A number of stakeholders expressed the view that there is inadequate knowledge about the functioning of the BCLME as an ecosystem, and its true value as a provider of ecological services. This is partly because there is a shortage of marine scientists in all three BCLME countries, not enough bursaries for aspiring students, inadequate appreciation by high-level decision makers (and the general public) about the value of nature as a provider of essential goods and services, and inadequate knowledge about the vulnerability of the environment to human-induced impacts. It was mentioned that the SEA should refer to the TEEB report edited by economist Pavon Sukdev (The Economics of Ecosystems and Biodiversity Report), which highlights the economic value of oceans and shares lessons learnt from various parts of the world.

Stakeholders suggested engaging natural resource economists to work with each of the different sectors to determine their long-term sustainability (and opportunity costs of certain sectors upon others) in the SEA, so that decision-making could be well informed. It was acknowledged that some Resource Accounts have been compiled for the Region in the past, and that these need to be built upon during the SEA.

As already envisaged by the BCC, there is a need for relevant and coordinated data collection, standardised research and monitoring methodologies and formats and a central database/meta-database.

2.6. Data availability and gaps

This section of the report summarises the extent of knowledge about the BCLME in the context of its sensitivity to development impacts. It is not a summary of all the literature that exists on the BCLME – the Bibliography serves that purpose, as does the BCLME website.

Industrial development and pollution

Large gaps in knowledge exist regarding the atmospheric drivers of oceanic processes and the complex bio-geo-chemical processes that are necessary to keep systems like the BCLME biologically healthy. As a result, a precautionary approach needs to be adopted in decision-making for heavy industries that will discharge substances about which there is no known data[11], into the ocean. The health of entire towns have been severely affected in the past due to environmental ignorance regarding the ecotoxicological effect of industrial processes on the food chain (e.g. Minamata disease).

Physical mapping, status and threats to biodiversity

A useful overview of the coastal environment (the physical, biotic and some social aspects) of the Angolan, Namibian and South African (west) coastal zones was commissioned by UNDP and completed by the CSIR in 1998 (CSIR, 1999). This comprehensive study drew on existing, available information and identified major gaps in knowledge, which could be addressed by the BCLME.

The regional AfrOBIS (African Ocean Biogeographic Information System) data centre (which stores data for Africa) should provide a list of known species that exist within the BCLME. A large number of regional guides to the marine fauna and flora are also available.

For the purposes of the SEA the most useful overviews on biodiversity in the BCLME include:- CSIR (1999); Bianchi et al (1999); Lombard & Strauss (2004); Griffiths et al 2010 and Sink et al (2011). The last two documents, in particular, offer up-to-date, comprehensive assessments of the knowledge available on South Africa's marine biota and the status of that country's marine/coastal biodiversity and ecosystems. Even in South Africa, where the most taxonomic work has been done, many taxa remain poorly documented (Griffiths et al 2010). Almost no coastal benthic invertebrate samples have been collected since 1980, and 83% of these are from depths of less than 100 m. Thus, the abyssal zone – even in South Africa - remains almost completely unexplored (ibid).

Neither Namibia nor Angola have in-depth assessments of their marine biota and large gaps in knowledge exist especially for Angola; although BP Angola (2012) does provide a superficial overview of marine fauna and flora in the northern Benguela and a guide to sensitive environmental 'hotspots'. Reviews of specific intertidal communities (Rocky shores and sandy beaches) in Angola and (mostly) Namibia were done (mostly) in the 1970s – 1990s[12] but no literature was located to show how these communities might have changed since then.

Determining the form of key predator-prey relationships is critical for understanding marine ecosystem dynamics (Cury et al 2011). Furthermore, monitoring the health of top predators populations provides useful information on the overall health of marine ecosystems. The literature review suggests that the majority of the work done throughout the BCLME does indeed pertain to top-predators. Apart from the economically important fish species this work focuses mainly on sea-birds (extremely well documented since the 1960s[13]), seals and

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[11] Only a very small fraction of the several million chemical substance known to man have adequate detailed toxicological data profiles.

[12] Including Kensley & Penrith, 1973; Kensley & Penrith 1980; Penrith & Kensley, 1970; Bustamante, *et al* 1993 ; McLachlan1985; McLachlan & De Ruyck 1993; Tarr *et al* 1985)

[13] This literature includes but is not restricted to: Berry, 1976; Crawford, 1978 ; Kriel *et al* 1980; Crawford, 1981; Cooper 1982; Duffy *et al* 1987; Cordes 1998; Underhill & Crawford 2005; Crawford 1995; Simmons *et al* 2006; Underhill et al 2006; Lewis *et al* 2006, Simmons & Brown, 2007; Kemper et al 2007; Crawford *et al* 2007; Crawford *et al* 2007 (a); Crawford *et al* 2007 (b); Dean *et al* 2002; Ludynia *et al* 2010; Braby *et al* 2009; Braby *et al* 2011; Braby *et*

cetaceans although some very useful work has also been conducted on sharks (e.g. BCLME 2007 (c)). This cache of literature provides useful information on changes within the BCLME ecosystem over time. Some highlights include:

- Fifteen species of seabirds breed in the BCLME (Underhill and Crawford, 2005; Kemper et al 2007). A recent assessment of their conservation status (Kemper et al 2007) shows that three of these birds are vulnerable (the African Penguin, Cape gannet, Cape cormorant), three are near threatened (Great White Pelican, Damara tern and Caspian tern); one species is endangered (Bank Cormorant) and; one species is critically endangered (Leaches Storm Petrel).
- African Penguin and gannet numbers breeding in Namibia have decreased by 90% and 95%, respectively since 1957. Cape Cormorants breeding in Namibia have decreased by 76% since the 1970s (Lewis et al 2006; Crawford 2007)
- The inshore habitat of Heaviside's dolphin places it at risk from commercial fishing operations and has led to concerns that the depletion of regional populations may result in loss of locally adapted genetic variation (Janse Van Vuuren et al, 2002).
- Although considerable efforts have been made to protect the breeding sites of the rare and near threatened, ground nesting Damara tern from being destroyed by off-road recreational drivers in Namibia (Braby et al 2009; Braby et al 2012), these authors emphasise that these should not be the only protection measures taken for this species and other migratory seabirds which spend extended periods of time in their non-breeding areas (Braby et al 2011).
- Recent surveys (conducted between 2003 and 2010) show a small reoccurrence of southern Right Whales – a species that was severely depleted by early nineteenth century whaling - in Namibian and northern Cape waters (Roux et al 2011).
- Aerial censuses of Cape fur seal colonies, spanning four decades (1972–2009) in the three BCLME countries show an increase in the number of breeding colonies from 23 in 1973 to 40 in 2009. Despite the increase in colonies seal numbers declined at most colonies in the south of Namibia while several new breeding colonies developed in the northern part of Namibia and one in southern Angola. The overall size of the population in 2009 was similar to that of the early 1990s (Kirkman et al 2012).

A description (with some maps) of the rivers/estuaries, climate, vegetation, terrestrial fauna, marine fauna and conservation areas is provided in this document. The physical geography summarized in CSIR (1999) should be used in the SEA background information chapter.

A more up to date document is provided by the Angolan Coastal Sensitivity Mapping project (presented in BP Angola 2012). Although superficial some of the information provided in this document can be used to inform the SEA regarding the current situation with respect to Angola's coastline. It includes:-

- Maps showing 59 areas considered to be sensitive to oil spills (7 areas in Cabinda Province; 22 in Zaire; 11 in Bengo; 11 in Luanda; 8 in Kwanza Sol)
- Maps showing the main fishing villages in each of the above-mentioned provinces.
- For each of the 59 sensitive sites, a superficial description of the coastal soil

al 2012)

types /geology, vegetation, avifauna, fish, sea reptiles and mammals settlements (size, main economic activities, access to telecommunications) is provided.

The Benguela Environment Fisheries Interaction & Training Programme (BENEFIT) was commissioned to undertake a biodiversity assessment and mapping research programme. It consisted of four component projects which aimed to bring conservation planning to an operational level in each of the three countries , *viz:-*

- A Physical mapping project (BEP/BAC/03/02)
- A Biological mapping project (BEP/BAC/03/03) Namibia and Angola not located in the literature
- A Estuary project (BEP/BAC/03/04) ;
- A Threats project ((BEP/BAC/03/05) Namibia and Angola not located in the literature

The Physical Mapping Project covered the shoreline, shallow water and offshore marine areas between Cabinda and Port Elizabeth. This work, presented in De Cauwer (2007), provides an important foundation for an assessment of the status and threats of biodiversity within the BCLME region. It includes:-

- A comparison of the GEBCO and ETOPO global elevation datasets with hydro acoustic measurements for the marine areas of the BCLME region.
- In addition to established datasets, datasets comprised of new data layers.[14]

These datasets provided the information to draw up maps depicting the coastline, off shore islands, bathymetry, marine sediments, intertidal coast types, harbours, protected zones, mining areas, human transformation of the coastline, EEZ, roads, untrawlable grounds, seamounts, marine canyons, continental shelf and others.

- Data layers that could not be established included: classification of marine sediments for Angola, untrawable grounds for South Africa and fog data for Angola.
- Datasets with weaknesses include the Angolan bathymetry close to the coast; the texture of marine sediments; and seamounts and marine canyons.

A detailed description (with some maps) of the climatology, offshore islands, rivers/estuaries/lagoons, pans, vegetation, terrestrial fauna, marine fauna and conservation areas for the Angolan, Namibian and western Cape coastlines can be accessed from CSIR (1999), de Ceuver (2007). These comprehensive studies drew on existing, available information and identified major gaps in knowledge some of which have been addressed by the BCLME and BENEFIT programmes.

Regarding biodiversity: diverse and healthy ecosystems underpin ecosystem processes, resilience (including resistance, recovery and reversibility), and thus the sustainability of ecosystem services. In the BCLME a high percentage of marine and coastal habitat types have no protection and many are threatened[15]. Offshore, the

[14] NB. The datasets established for this project are not all owned by the BCLME/BENEFIT project and that their main purpose is to serve as an input into the MOM project. Certain datasets have copyrights, cannot be distributed to third parties and/or need acknowledgement or referencing. It is therefore not permissible to freely distribute the physical mapping dataset as is. The BCLME must take cognisance of this fact as there are legal implications associated with this. Accompanying letter of agreement with data sources are referred.

[15] In South Africa, 40% of all marine and coastal habitat types including many habitat types in Namaqualand and the southwestern Cape (both within the BCLME) have no protection status.

southern Benguela has the most threatened habitat types in South Africa, including productive habitats that support important commercial fisheries (Sink 2011).

A full assessment of the status and threats of biodiversity within the BCLME region is not only necessary to assist in the shift towards an Ecosystems Approach to Fisheries (EAF) management but also for conservation and coastal zone planning. Sink *et a*l (2011) offers an up to date, comprehensive assessment of the state of South Africa's marine/coastal biodiversity and ecosystems. Neither Namibia nor Angola has similar in-depth assessments on ecosystem health.

Sink *et a*l (2011) will be useful for the SEA team. This document:-

- Classifies all of South Africa's marine and coastal habitats (and includes habitat maps for the coast, ocean floor and the open ocean);
- Provides a data driven review of the pressures on marine and coastal biodiversity
- Provides an overview of the state of knowledge regarding marine taxonomy, marine alien and invasive species and a review of marine genetic biodiversity, and
- Provides information on knowledge gaps and research priorities and discusses priority actions.

South Africa's National Estuary Biodiversity Plan (Turpie *et al* 2012) should also provide valuable information and data for the South African component of the SEA.

BCLME (2008 c) assessed the estuarine biodiversity along the coastline of the three BCLME countries. The baseline biodiversity survey provides valuable information for management. Detailed surveys of the two transboundary estuaries (Orange and Kunene and the Kwanza and Catumbela) were conducted between 2004 and 2007. In addition surveys were conducted on a number of smaller systems (Dande, Loge, Coporolo and Carunjamba) in 2007 (BCLME 2008 c). Data was collected on species, communities and biotopes of estuarine areas (including associated floodplains, salt marshes and mangroves).

3. BCLME biophysical overview

The Benguela Current (Figure 3.1) is located on the western margin of Southern Africa. Although most authors emphasise that the BCLME extends all the way to Cabinda in northern Angola, Government of Angola (2007) only considers the southern part of the country to be influenced by the cold northward flowing Benguela current – with an almost 5 ^{o}C difference in temperature between the two regions. The Angolan coast can be divided into three different climatic zones:

- Northern: from Cabinda to the South of Luanda (5-9°S)
- Centre: from the south of Luanda to Benguela (9-13°S)
- Southern: from Benguela to the Cunene River (13-17.3°S)

The northern and central zones in Angola experience the same meteorological features and the warm equatorial and Angola currents. For these reasons they are considered to be situated within the same ecosystem (with similar temperatures, salinity, oxygen content and biodiversity) although the Congo River plume seasonally affects the northern coast (especially with respect to salinity and nutrient transport).

By contrast the southern Angolan region (from Benguela – Cunene river) is affected by the northern part of the Benguela current flowing from the Cape up to 15°S where it deflects westward converging with the southwards Angola warm current. The convergence zone (15-18°S) between the Angola and Benguela Current (the Angola-Benguela Front) has been the subject of much research, using both remotely sensed data as well as hydrographic data (the most relevant literature is listed in Government of Angola 2012).

Seasonal upwellings of nutrients occur in cells mainly off Cabinda (5°S) and off Luanda (9°S) – the northernmost upwellings (near Cabinda and Ambriz) are week and concentrated between 10km -70km offshore. They are not wind-driven (as they are in the southern part of Angola and along the Namibian coast) but are related to equatorial upwelling in the eastern Atlantic and can be explained by remote forcing from the western equatorial Atlantic (ibid). High productivity (concentrations of chlorophyll) found in the north of Angola does not depend only on the upwelling, but is enhanced by the nutrients and sediments transported by the Congo River.

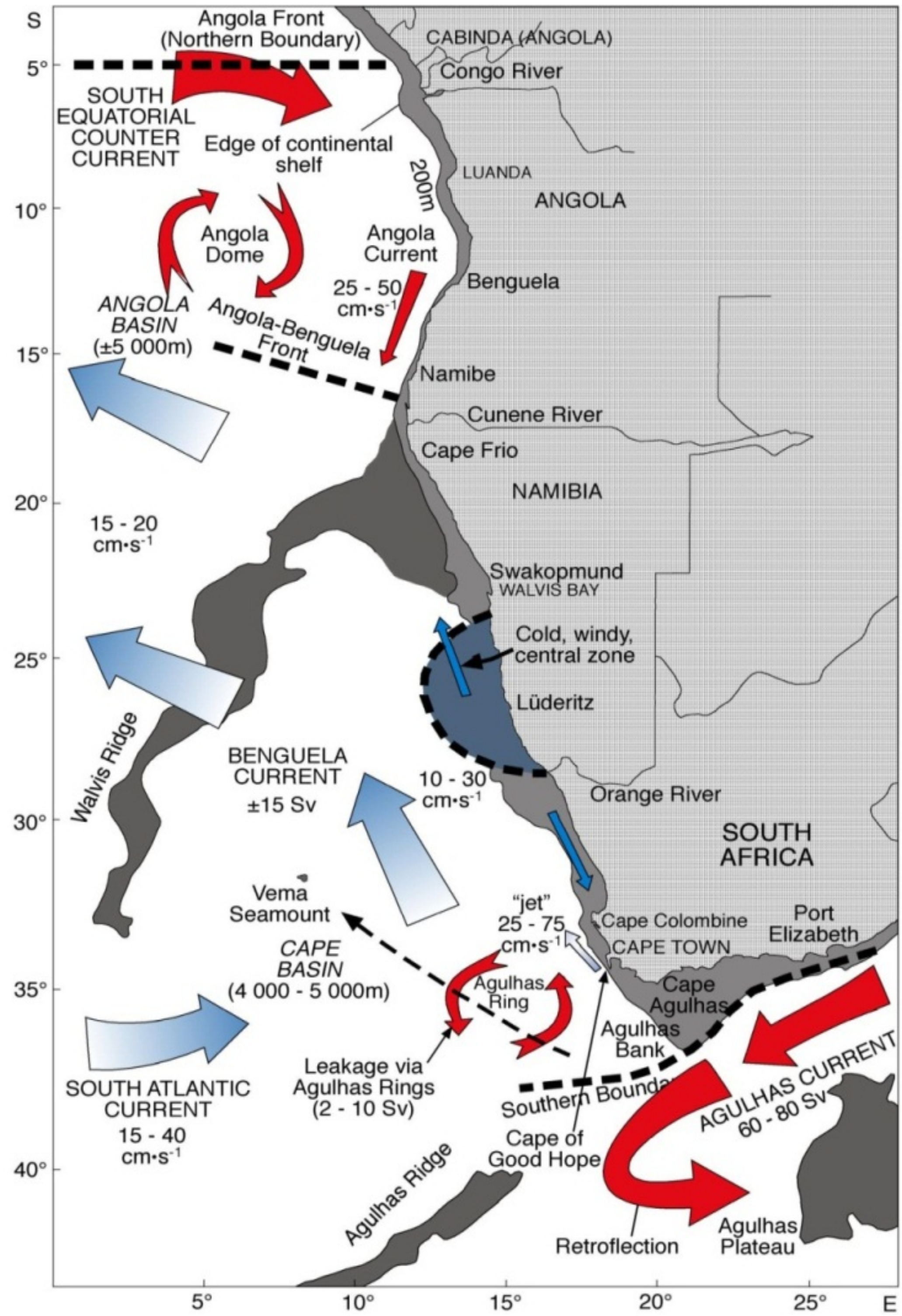

Figure 3.1: Main features of the BCLME.

The BCLME is primarily influenced by strong southerly winds that generate coastal upwelling which brings cold, nutrient-rich water to the surface. The System is bounded by a strong thermal front on its northern border, the Angola Benguela Front, and a fast-moving and warm western boundary current, the Agulhas Current, to the south-east. Driven mainly by the upwelling, the Benguela ecosystem is one of the more productive ocean areas in the world with mean annual primary production estimated to be more than 300 $gC.m^{-2}.y^{-1}$. This level of primary production places the BCLME in the category of Class I highly productive ecosystems. Driven by the high primary production, the higher trophic levels, including fishery resources and predators dependent on them, are also very productive.

The fisheries sector provides important social and economic benefits to all of the three countries but the importance in relation to other sectors differs considerably between them. In the case of Angola, the fisheries sector was estimated to have contributed 15.6 % of the national GDP in 2005 and 21.1 % in 2006 which placed it second only to the oil industry in terms of contribution (FAO National Fishery Sector Overview: Angola).

Unlike the other BCLME countries, Angola has a large artisanal component making it an important coastal resource for food security. Ninety per cent of the fish produced is sold in the domestic market and small-scale, artisanal fisheries are the main providers of livelihoods and food provision for many people in coastal areas. The most recent estimates available are that there are 102 fishing communities along the 1 650-kilometre coastline of Angola, made up of artisanal fishers and others involved with fishing-related activities on land. An estimated total of 130,000 to 140,000 people are involved in artisanal fishing in Angola, excluding those involved in buying, processing, distribution and marketing of fish. The fishing at sea is largely done by men while women engage in some shore-based fishing and play the major role in fish processing, selling and trading (Sowman et al. 2011).

Approximately 100,000 people, equivalent to 6.5% of Namibia's population, live in the main coastal centres of Swakopmund, Walvis Bay, Luderitz, Oranjemund and Henties Bay. Fisheries and aquaculture accounted for approximately 7.5% of the country's GDP in 2005 (FAO National Fishery Sector Overview: Namibia). Many of the coastal inhabitants depend on living marine resources for their livelihoods, either directly or indirectly. There are about 14,000 people working in the fishing and aquaculture industry in Namibia with nearly 6,000 working in the primary sector (including aquaculture) and nearly 8,000 in the secondary sector. Women work mainly in the processing factories (Sowman et al. 2011).

The fishery sector in South Africa is much more diverse than in Namibia and Angola and encompasses subsistence fishing through to high-value commercial fisheries. It should, however, be noted that the fishing sector in South Africa extends into the Agulhas system as well and along the length of the east coast up to the Mozambique border (although the Benguela system is the most productive region and supports the large commercial fisheries). Compared to Namibia, the fisheries sector in South Africa is a relatively very small component of the national economy: the contribution of fisheries to the national GDP in 2008 was approximately US$ 322.5 million, equivalent to about 0.04% of the country's GDP (FAO National Fishery Sector Overview: South Africa). Approximately 26,000 people are employed in the fisheries sector, most of them in commercial fisheries. At the artisanal level, there are approximately 34 communities engaged in subsistence or informal fishing along the Benguela part of South Africa's coastline, which includes nearly 2,400 informal fishers. As in the other two countries, women are mainly engaged in post-harvest activities (Sowman et al. 2011).

The BCLME undergoes high levels of environmental variability which increases the vulnerability of those dependent on fisheries, especially artisanal fishers, and others dependent on the ecosystem for their livelihoods. Incidence of Benguela Niños, low oxygen events and sulphur eruptions are some of the more extreme climatic and environmental perturbations that negatively impact ecosystem productivity in the region. This natural variability is being compounded by climate change impacts on the BCLME.

One of the primary direct impacts from humans on the BCLME is over-exploitation of living marine resources and other indirect environmental impacts from the fisheries sector. Fisheries management has been reasonably successful in regulating fisheries and several of the most important fishery resources in the region are currently being exploited in an optimal manner. For example the hakes *Merluccius capensis* and *M. paradoxus* (and to a lesser extent *M. poli* in Angolan waters) have in the past been heavily overexploited but are currently considered to be optimally exploited. The small pelagic sardine *Sardinops sagax*, and the Cape and Cunene horse mackerels *Trachurus capensis* and *T. trecae* are other important commercial stocks but which have historically been overexploited (Cochrane et al. 2009)[16]. Angola, for example has closed its midwater (industrial) trawl fishery for horse mackerel with the primary objective of protecting the resource for the artisanal fishers. Other important species suffering from over-exploitation include the geelbek *Atractoscion aequidens,* panga seabream *Pterogymnus laniarius*, red steenbras *Petrus rupestris*, deepsea red crab *Chaceon maritae*, West Coast rock lobster *Jasus lalandii* and abalone *Haliotis midae*.

Over the last century, Southern Africa has suffered from dramatic inter-annual changes in climate leading to severe droughts, increased occurrence of floods, variation in wind speed or disturbance in the marine or terrestrial ecosystems. Such variability of climate affects the agricultural industry, water reserves, fisheries and thus the Gross National Product. It has a particularly detrimental effect on rural subsistence farmers and fishermen, the health of people in rural areas and the management of a sustainable natural environment. The Pacific Ocean, the Indian Ocean and the Tropical Atlantic are important external drivers of the inter-annual variability. Moreover, the International Panel on Climate Change (IPCC, 2007) confirmed the anthropogenic footprint on global land and sea surface temperature (SST). Questions remain, though, about future climate at a regional scale in a world where CO_2, methane and other gases continue to rise and to what extent anthropogenic climate change has already taken place at a regional scale. The subject is complicated because an anthropogenic effect is superimposed on natural climate variability, however it seems that changes have occurred already since the 80's.

Angola's oceanography, like that in Namibia, is periodically affected by Benguela Niños (or warm water events) which cause much higher sea temperatures, altered salinity, altered thermocline characteristics, and heavier than usual coastal rainfall. Flooding of major rivers (Congo and Cuanza) and reduced biomass of commercially important pelagic fish species (e.g. sardinella, Cunene horse mackerel and sardines) also occur. Although environmental variability does not seem to be extreme in the Angolan marine environment the literature does highlight the periodic presence of Harmful Algal Blooms (HABs) which can dramatically affect the Angolan fishing industry.

Progress has been achieved establishing a number of Marine Protected Areas (MPAs) in South Africa, however the area that is protected (approximately 18 % of the entire coastline but only 1.6% of the Exclusive Economic Zone) is still far from

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[16] Note that in Namibia the sardine resource remains critically overexploited and has not fully recovered from exploitation in the 1960's

the 10% goal set by the United Nations Convention on Biodiversity (Pichegru et al 2009). Of the 21 established MPAs in South Africa, 8 exist within the BCLME region[17]. Despite this, most of these areas are located in the southern Cape – leaving the west coast of South Africa and its offshore areas almost totally neglected. MPA's in South Africa are mostly managed through the Department of Environmental Affairs and are protected under the Marine and Living Resources Act. In some cases Government has signed Memorandum of Agreements with the local conservation agencies to ensure effective management of the MPA's. Many of the conservation agencies are hoping to develop volunteer groups that will assist with various marine related projects.

In 2009 Namibia's first MPA was proclaimed (400km length of coast between Meob Bay to Chameis Bay inclusive of the Guano islands, rocky islets and surrounding areas to a distance of 30 km offshore). This represents 25% of the Namibian coastline (Robertson et al 2012).

4. BCLME policies, laws and institutions overview

This section of the Scoping Report provides a brief overview of the most relevant policies and laws relating to the management of environmental impacts in the BCLME. Since far more extensive analyses are contained in various BCLME-commissioned reports, there is little point in repeating the bulk of the available literature. The summary below is intended to provide a context for the SEA, which will *inter alia* be required to update the legal and policy framework and to offer a succinct critique of the adequacy and consistency of the policies, laws and regulations in effect in the BCLME countries.

Fisheries and aquaculture management

The fisheries sector in the BCLME countries is regulated by fisheries specific laws, regulations and policies. According to Envirofish Africa (2006), South Africa has the most advanced legal framework, including the Marine Living Resources Act, 18 of 1998, various Constitutional provisions, the Maritime Zones Act 15 of 1994, the Promotion of Administrative Justice Act 3 of 2000 and the Promotion of Access to Information Act 2 of 2000.

Namibian fisheries administration is governed by its Marine Resources Act, 27 of 2000, and the Constitution also contains environmental clauses pertinent to the management of this sector and the environment in general. The Angolan fisheries sector is regulated in terms of the Aquatic Biological Resources Act, 2004 and the Fisheries Act, Law No 20/92.

The three countries are also each bound by international treaties and agreements regulating fishing. These include the United Nations Convention on the Law of the Seas (UNCLOS) and the Food and Agriculture Organisation's Code of Conduct for Responsible Fisheries. South Africa and Namibia have acceded to (South Africa) and ratified (Namibia) the 1995 UN Fish Stocks Agreement for the Conservation and Management of Straddling Stocks and Highly Migratory Stocks. Angola has neither

[17] Betty's Bay, Bird island, De Hoop,False bay , Langebaan lagoon,Table Mountain, and StilBaai

signed nor acceded to, or ratified this Convention. Furthermore, all three BCLME countries are bound by the SADC Fishing Protocol, ICCAT (International Commission for the Conservation of Atlantic Tuna), SEAFO (South-East Atlantic Fisheries Organisation), CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) (*ibid*).

Environmental Assessment

Angola

Angola's 1998 Environment Framework Law (Lei de Bases do Ambiente*)*, No. 5/98, provides the framework for all environmental legislation and regulations in Angola. It gives the definitions of important concepts, such as the protection, preservation and conservation of the environment, the promotion of quality of life, and the use of natural resources. The Law incorporates the main international sustainable development declarations and agendas (e.g. Agenda 21), and establishes citizens' rights and responsibilities. Article 14 allows for the establishment of environmental protection areas and the setting of rules for those areas, including the identification of activities that would be prohibited or permitted in protected areas and their surroundings.

Article 16 of the Law makes provision for mandatory EIAs for all undertakings that may have an impact on the balance and wellbeing of the environment and society. The 2004 Decree on Environmental Impact Assessment (Decreto sobre Avaliação de Impacte Ambiental), aims to ensure better environmental protection, particularly in terms of human activities likely to have an impact on the environment (Walmsley and Patel, 2011). The EIA Decree does not refer to SEAs or assessments to be conducted for policies, plans or programmes.

Decree No. 59/07 on Environmental Licensing provides additional legislation on EIAs by providing guidance on topics such as: which project should be subject to an EIA; what elements are to be included in an Environmental Impact Study; the nature and extent of public participation; the entity responsible for compliance with these legal requirements; and the EIA monitoring process (ibid).

Angola's Environmental Damage Regulations (Decree 194 of 2011) includes the following:

- The polluter pays principle;
- Strict liability (regardless of culpability) for environmental damage;
- Powers of the regulatory authority (the Ministry of Environment) to prevent or reduce the risk of environmental injury, including requiring businesses to develop prevention programmes and make disclosures in case of an imminent threat to the environment;
- Financial guarantees being payable for remediation or compensation of environmental damage in the form of insurance policies, bank guarantees, company reserves or other mechanisms;
- Individuals and non-governmental organisations granted *locus standi* (legal standing) to pursue legal action (including class action suits) to avoid, remedy and/or obtain compensation for environmental damage; and

- Strict penalties, including fines that can reach US$100 million, as well as cancellation of Environmental Licences (www.mirandalawfirm.com).

In Angola, an **Environmental Licence** is required for all activities that may have a significant environmental impact. The Environmental Licence is issued on the basis of the findings of an EIA and is required before the issuance of any other permits or licences under other laws.[18]

Namibia

The Namibian Constitution has a number of provisions for enhancing environmental protection and pursuing sustainable development[19], with Article 95(l) being particularly important in that it commits the state to actively promoting and maintaining the welfare of the people by adopting policies aimed at the:

> … maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future …

The Ministry of Environment and Tourism (MET) is responsible for safeguarding Namibia's environmental resources, and since Independence MET has implemented far-reaching policy and legislative reforms in the environmental sphere in an attempt to alleviate many of the constraints that the environment places upon people and vice versa. These reforms were also aimed at encouraging various innovative, collaborative partnerships between important players in the environmental field, such as ministries with environmental interests within their areas of jurisdiction, non-governmental organisations, community-based organisations and donor agencies of various countries.

Currently EIAs are guided and reviewed by the Directorate of Environmental Affairs (DEA) in the MET. The DEA is also in charge of pollution control and waste management, and overall coordination of environmental issues within the Namibian government.

The Environmental Management Act of 2007 (EMA) is in line with modern legislative trends, including:

- Adherence to the polluter pays principle;
- The inherent need to incorporate adequate provisions to achieve 'reduction-at-source' in the areas of pollution control and waste management;
- The need to consider alternatives and to avoid or minimise negative impacts wherever possible;
- The costs of EIAs being borne by the proponent, who is also responsible for ensuring that the EIA and the EIA report are of an acceptable standard;
- The need for a binding agreement between the proponent and government, based on the recommendations contained in the EIA report, that specifies how the environmental issues will be dealt with in project implementation; and

[18] Article 17 of the Environment Framework Law.
[19] Republic of Namibia, 1990. *The Constitution of the Republic of Namibia*. Windhoek: Government of Namibia.

- The need for public participation in the EIA process.

Accompanying the EMA is a set of Regulations that specify the process requirements for undertaking assessments of policies, plans and programmes (strategic environmental assessment) and of projects (EIA), developing environmental management plans, and undertaking environmental monitoring.

Before a developer can commence with an activity listed in Schedule 1 of the Regulations to the EMA s/he must obtain Environmental Clearance.

However, the Environmental Clearance from MET is not blanket permission to implement the project. The proponent is still required to obtain a sectoral licence or permit, depending on the nature of the envisaged project. In most cases, sector ministries first consult the EIA report before considering the proponent's applications for permits.

South Africa

The Government of South Africa is constituted as having national, provincial and local spheres that are distinct but interdependent and interrelated. The Constitution allocates legislative and administrative functions to all three spheres of government, giving a wide range of government agencies responsibility for environmental management.[20]

Environmental provisions are included in the Bill of Rights in Chapter 2 of the Constitution of South Africa Act, No. 108 of 1996. In terms of section 24 of the Act, everyone has the right:

(a) to an environment that is not harmful to their health or well-being; and

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

- prevent pollution and ecological degradation;
- promote conservation; and
- secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The Bill of Rights in Chapter 2 of the Constitution entrenches the right to information; the right to freedom of expression; the right to participate in political activity; the right to administrative justice; and fundamental science, cultural, legal, economic and environmental rights. In addition, the Constitution requires all legislatures to facilitate public involvement in the legislative and other policy processes. Citizens have the right to engage in public initiatives and processes on an ongoing basis.

[20] Republic of South Africa, 1996. *Constitution of South Africa.* Pretoria: Government Printer.

The Department of Environmental Affairs (DEA) is responsible for EIA at both national and provincial levels. Policy formulation and coordination takes place at national level, while approval of EIAs for most development proposals has been devolved to the provinces.

In terms of section 42(1) of the National Environmental Management Amendment Act (NEMA) of 2003, the Minister of Water and Environmental Affairs can designate the provinces as competent authorities, empowering them to authorise development activities in terms of the EIA Regulations. The provinces may, in turn, devolve this competency to their local authorities, as provided for in section 42A(1)(c) of the National Environmental Management Amendment Act of 2003. In most provinces, the administration function for EIA is located within portfolios dealing with natural resource management, rural development, tourism, conservation, economic development or agriculture. In terms of the new EIA Regulations, the authorities are required to perform a number of functions within certain timeframes. The main obligations of the provincial departments are as follows:

- Provide the applicant with any relevant guidelines and information.
- Advise the applicant on the nature and processes that must be followed in order to comply with the Act and Regulations.
- Consult with other competent authorities and other organs of state to avoid duplication of effort.
- Receive and acknowledge receipt of applications within the stipulated timeframe.

The NEMA was promulgated to give effect to the Environmental Management Policy. The Act repealed most of the Environment Conservation Act, No. 73 of 1989. The NEMA was subsequently amended on several occasions. The aim of NEMA is to provide for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance, and procedures for coordinating environmental functions exercised by organs of state.

The principles set out in section 2 of Chapter 1 underpin all other related Acts and policies and form the basis of sustainable development in the country. They apply to all organs of state that may have a significant effect on the environment through their actions. The principles are summarised as follows:

2(2) Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.

2(3) Development must be socially, environmentally and economically sustainable.

2(4)(a) Sustainable development requires the consideration of the following:

i. Disturbance to biological diversity must be avoided or minimised and remedied.
ii. Pollution of the environment must be avoided or minimised and remedied.
iii. Disturbance of landscapes and sites that constitute the nation's cultural heritage must be avoided or minimised and remedied.

iv. Waste must be avoided or, where it cannot be avoided, consideration must be given to minimisation, reuse or recycling.
v. The use and exploitation of non-renewable resources must be responsible and equitable.
vi. The development, use and exploitation of renewable resources must be within sustainable limits.
vii. A risk-averse and cautious approach must be applied.
viii. Negative impacts on the environment and on people's environmental rights should be anticipated and prevented or minimised and remedied.

(b) Environmental management must be integrated and the best practicable environmental option should be pursued.

(c) Environmental justice should be pursued so that adverse environmental effects are not distributed in such a way as to discriminate unfairly against any person, particularly the most vulnerable.

(d) Equitable access to environmental resources, benefits and services to meet basic human needs and human wellbeing should be given due consideration.

(e) Responsibility for the environmental health and safety consequences of all policies, programmes, projects, products, processes, services and activities exists throughout the life cycle.

(f) Public participation is promoted, as well as building capacity among the most vulnerable and disadvantaged so that they can have meaningful participation.

(g) Decisions must consider the interests, needs and values of all interested and affected parties, including the recognition of traditional and ordinary knowledge.

(h) Community wellbeing and empowerment must be promoted through a variety of programmes.

(i) Social, economic and environmental impacts must be considered, assessed and evaluated, and decisions must be appropriate to the impact assessment findings.

(j) Workers have a right to refuse to do work that may be harmful to human or environmental health.

(k) Decisions must be made in a transparent and open manner, and access to information must be provided in accordance with the relevant laws, such as the Promotion of Access to Information Act, No. 2 of 2000.

(l) There must be intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment.

(m) Conflicts of interest between departments should be resolved through conflict resolution procedures.

(n) Global or international responsibilities relating to the environment must be discharged in the national interest.

(o) The environment is held in trust for the people; the beneficial use of resources must serve the public interest and the environment must be protected as the people's common heritage.

(p) The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be borne by those responsible for harming the environment.

(q) The role of women and youth in environmental management must be recognised and promoted.

(r) Sensitive, vulnerable, highly dynamic or stressed ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resources usage and development pressure.

The Regulations under the NEMA set out the processes that have to be followed in order to obtain an Environmental Authorisation and they specify the time that officials should take to arrive at decisions, the contents of reports, public participation and the use of environmental assessment professionals. An Environmental Authorisation is required before a developer can undertake any listed activity. In addition, several other permits, licences or authorisations may be required, depending on the type of activity contemplated.

5. Drivers and impacts

There are different ways to approach an SEA, the two most common being assessing cumulative impacts from the perspective of the receiving environment (e.g. threats to biodiversity), or by analysing the impacts of key development drivers (e.g. mining). The approach proposed in the ToRs for the SEA is to focus on the key drivers, for the following two main reasons:

- The drivers are linked sectorally to government policies, plans and programmes, so it is easier for the results of the SEA to influence strategic decision making processes (e.g. a country's industrialisation policy), and
- The proponents of sectors (e.g. government agencies) or projects (e.g. a desalination plant) or local authorities managing towns, will find the SEA more useful if they can easily access the chapters of relevance to them.

However, the disadvantage of a sectoral approach is that integration is more difficult to achieve, and the 'big picture', becomes fragmented. Thus, whilst a development driver-linked approach is favoured, it will be essential for the SEA to stress the extent of cumulative impacts within and between sectors, and to identify synergistic and antagonistic effects. The initial assessment of sector and cumulative impacts provided in this Scoping Report, attempts to do this.

The drivers discussed below are those sectors that are regarded as having the greatest impacts on the BCLME. They are not arranged in order of priority concern – doing so will be a requirement of the SEA itself.

5.1. Seabed and Coastal Mining and Dredging

5.1.1 Current extent

The coast, nearshore and shelf environments of the Benguela Current region hold rich reserves of minerals, particularly diamonds, heavy minerals and phosphate.

Diamonds

All of the coastal and marine diamond deposits are secondary, with the original source of the diamonds being the kimberlites in South Africa and Botswana. As the kimberlite pipes were eroded over time, the diamonds were transported via the Orange River and its tributaries and deposited on river terraces and in palaeo channels along most of their lengths. At the coast, the diamonds were swept out to sea and, through a combination of currents and winds, were transported northwards. It is thought that the Orange River changed course a few times over the millennia and at some time it was in the vicinity of the current Olifants River mouth. Thus today, diamonds may be found in old marine terraces and palaeo beaches on land, and in the current beach, inshore and deeper marine environments. As a result, mining concessions have been granted from the Kunene River mouth on the Namibian-Angolan border in the north to St Helena Bay in the south (Figures5.1 and 5.2).

Namibia has the richest marine diamond deposits in the world, with an estimated reserve of over 1.5 billion carats. In 2006, Namibian production from onshore, beach and marine sources peaked at 2.3 million carats, of which marine production contributed a record 57% of Namibia's total diamond production (Namibian Chamber of Mines, 2011). However, the global recession of 2008 hit diamond sales particularly hard and production declined by 61% between 2007 and 2009, with deepwater marine production ceasing completely in 2009 (Figure 5.3). The recession also forced a number of smaller companies (Diamond Fields International (DFI) and Sakawe) out of business, leaving Namdeb[21] as the sole Namibian diamond producer at present. Production has recovered slightly in 2010 and 2011, but not yet to the same pre-recession levels (Figure 5.3).

[21] Namdeb Diamond Company, comprises an equal partnership between De Beers and the Namibian government.

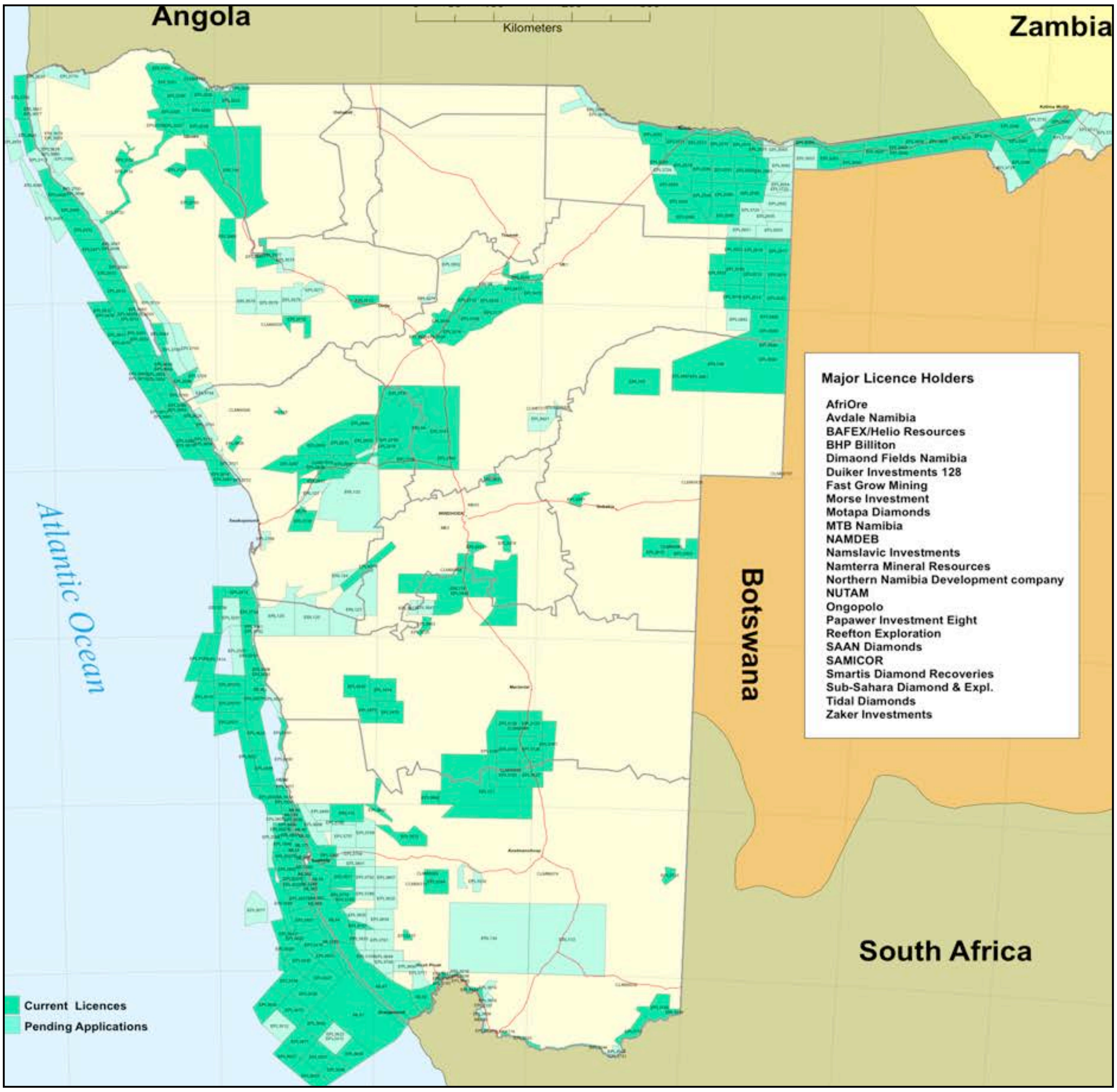

Figure 5.1: Diamond prospecting and mining licences in Namibia (source Ministry of Mines and Energy).

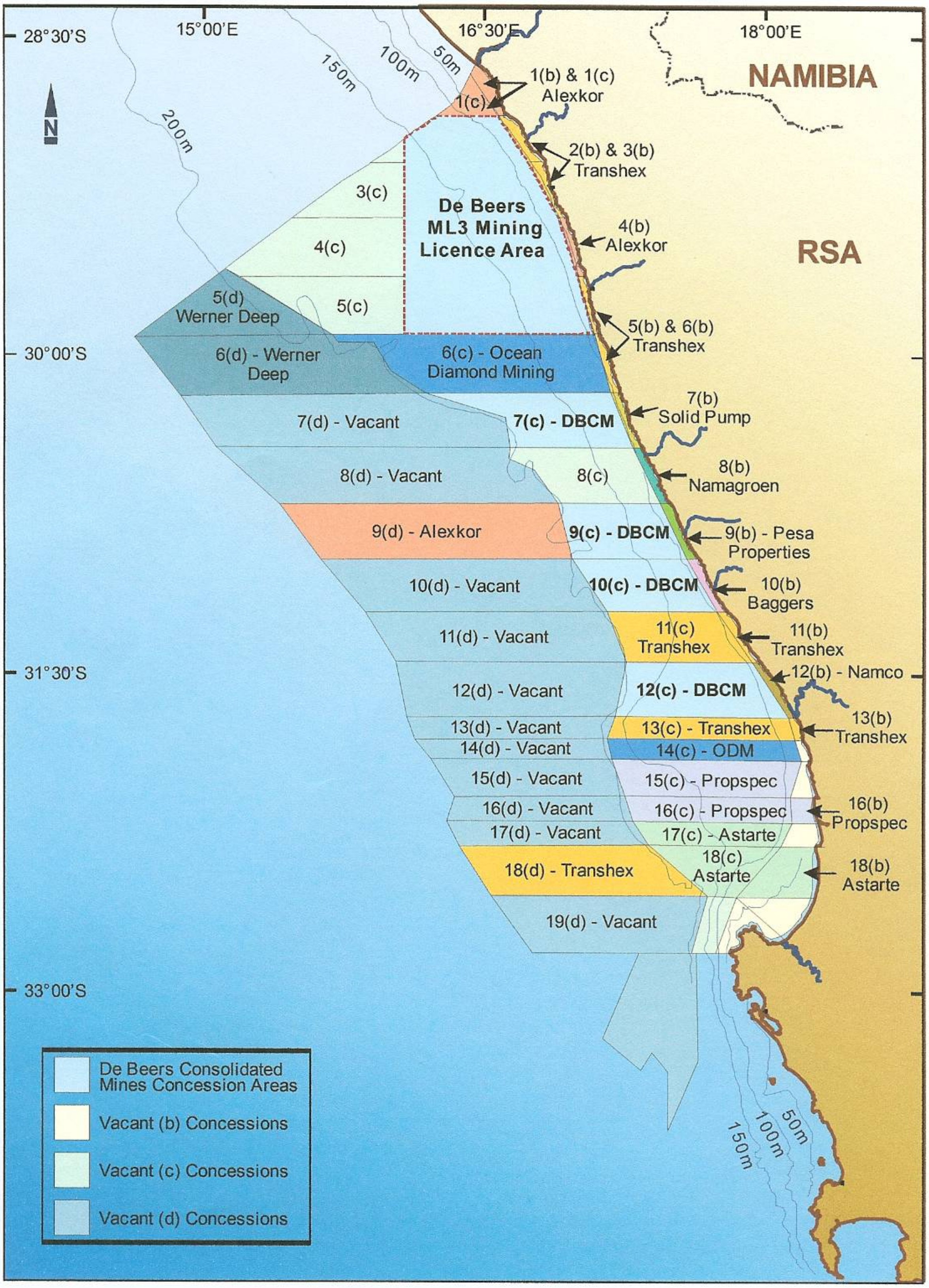

Figure 5.2: South African coastal and marine diamond mining concession areas (from Pisces Environmental Services, 2005)

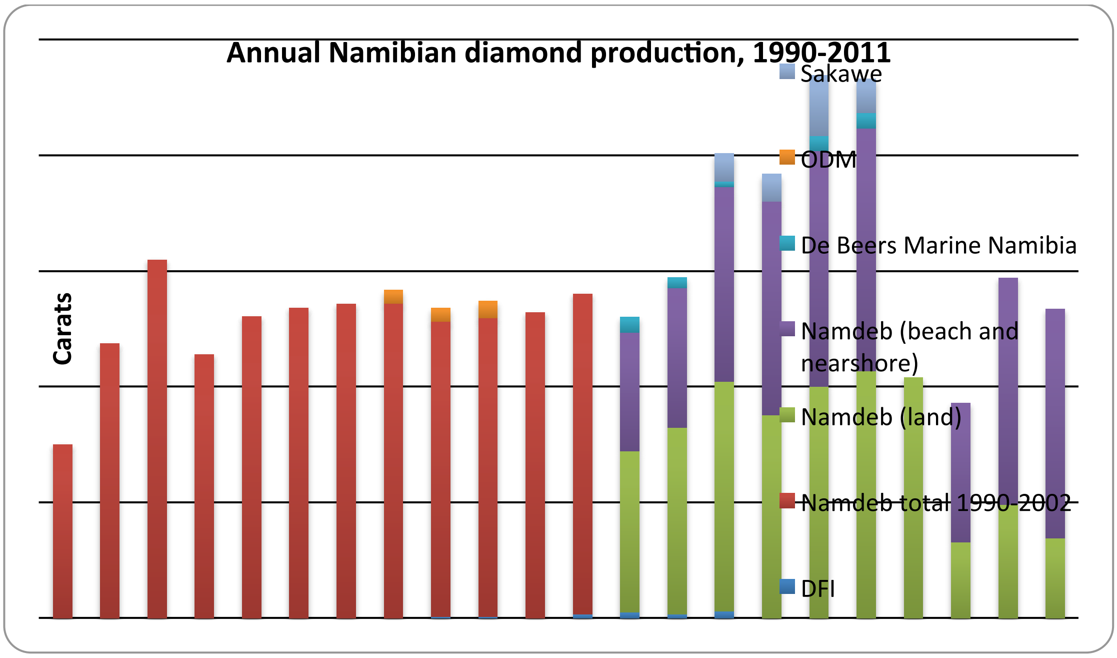

Figure 5.3: Annual Namibian diamond production, 1990-2011. (Source: Namibian Chamber of Mines, 2011 and Namdeb, 2011).

Namdeb holds six mining licences: Mining Area 1 (land and nearshore), Orange River (land), Bogenfels, Elizabeth Bay and Douglas Bay (land and nearshore), and Atlantic 1 (deepwater) (Figure 5.1). The bulk of production now comes from the marine concessions, as the land resources are becoming depleted. Consequently, Namdeb intends to return their mining vessels, to production in 2012 (Namdeb, 2011).

The considerable potential of Namibia's marine deposits has resulted in rapid advances in marine diamond extraction technology. Modern deepwater mining methods involve the use of drill systems or seabed crawlers (Plate 5.1). Both systems loosen and remove unconsolidated seabed sediments which are then airlifted or pumped to a dynamically moored vessel for processing (www.benguelacc.org).

Plate 5.1: The Debmar Atlantic, moored some 35 kilometers off the Namibian Coastline (www.debeersgroup.com)

South Africa's diamond production totalled 15.8 million carats in 2005, but this fell to just over 6 million carats in 2009 as a result of the global recession. However the diamond market recovered slightly in 2010 and production increased by 45% to 8.9 million carats (South African Chamber of Mines, 2011). Most of this production came from kimberlites and alluvial diamond mining outside of the Benguela Current area. Production within the BCLME region from the old land-based mines along the South African west coast and the marine mining operations has almost ceased, with only 43,248 carats mined in 2011 (<0.5% of the total mined).

The potentially economic, land-based diamond deposits in South Africa stretch from just south of Hondeklip Bay to Alexander Bay in the north at the Orange River mouth (Figure 5.2). These deposits are or were mined by three companies: Alexkor, De Beers Consolidated Mines (DBCM) and TransHex.

The Alexkor mine was the subject of a successful land claim by the Richtersveld community; the Deed of Settlement, dated 22 April 2007 saw the transfer of the land mining rights to the Richtersveld Mining Company (RMC), with Alexkor retaining the marine mining rights for eight concessions and the adjacent surf zones. However, a Pooling and Sharing Joint Venture (PSJV) established in April 2011 between Alexkor and the RMC means that the JV now holds the mining rights to the land and marine concessions from Alexander Bay in the north to just south of Port Nolloth. While the negotiations have been taking place, land mining was placed on care and maintenance and nearshore sea mining was carried out by contractors, who produced a total of 20,143 carats in 2011 from only 8 sea days. Beach mining produced 7,724 carats in the same period.

Until May 2011, DBCM owned the De Beers Namaqualand Mines, which occupied a long stretch of coast from Port Nolloth in the north to Koiingnaas in the south. DBCM entered into a R225 million sale agreement with TransHex for Namaqualand Mines, but this sum has since been revised downwards to R166 million due to the exclusion of certain assets and environmental liabilities. As a result of these negotiations, there has been no production from Namaqualand mines since 2011.

De Beers Marine ceased operations in their deep water concessions following the economic crisis, and although they have not restarted mining in this area, the company has entered into a 6-year charter arrangement with Debmarine Namibia, enabling the deployment of the *Peace In Africa* mining vessel in Namibian waters in 2012 (De Beers, 2011).

The mining rights for the area immediately to the south of Namaqualand Mines, around Hondeklip Bay, as well as an area near the Olifants River mouth, both used to be held by TransHex, but these mines are now closed. However, TransHex has continued mining its five shallow water concessions (up to 25 m depth) using contractors. In 2012, a total of 6,701 carats were produced (TransHex, 2011).

Pandamarine and Namagroen both own shallow water concessions in the area between Hondeklip Bay and the Olifants River mouth, but little data on production is available (Figure 5.2).

Although there has been some prospecting for diamonds along the Angolan coastline, no concessions have yet been allocated (www.pandamarine.co.za).

Heavy Minerals

Namakwa Sands undertakes the mining and beneficiation of heavy minerals. The operation is located on the west coast of South Africa and operates facilities at three separate sites. The mine and the concentration plants are located at Brand-se-Baai, 385km north of Cape Town. Concentrate is transported to the mineral separation plant by truck, which is located at Koeknaap, 60km from the mine. Here ilmenite, zircon and rutile are recovered before the products are transported by rail to the smelter near Saldanha Bay, 150km from Cape Town. Namakwa Sands operates two furnaces where ilmenite is smelted to produce titanium slag and pig iron. The Namakwa Sands operation started in 1994 and is one of the largest mineral sand operations in the world.

Plate 5.2: The Namakwa sands heavy minerals mine (www.geoscience.org.za)

A second heavy mineral deposit, known as the Tormin deposit, occurs on the west coast, some 40km west-north-west of Vredendal, with an estimated reserve of 4.9 mt grading at 42.3% heavy minerals. A Reconnaissance Permit was granted to Mineral Resources Ltd (a subsidiary of the ASX-listed Mineral Commodities Ltd) in 2009 and Bateman completed a feasibility study in 2005 indicating a base case of 40,000 tpa zircon and 12,000 tpa high titanium over a 3-5 year life of mine period. A definitive feasibility study was commissioned in 2009 and the Environmental Permit was finally obtained in July 2012, but it is not known if or when this deposit will be mined.

Phosphate

The nutrient-rich, cold, upwelling system of the Benguela current is conducive to the growth of prolific marine organisms, which over time, decompose to form phosphates. Offshore phosphate deposits occur on the continental shelf stretching from Port Elizabeth to Cape Town (Agulhas Bank) and from Cape Town to Lambert's Bay. Scattered deposits have also been found off the Namibian coast near Walvis Bay. Deposits consist of scattered nodules and sands lying at depths ranging from 100 – 1,000 m. The nodules are comparatively low grade compared to land-based deposits, averaging 16% P_2O_5 and until recently, these marine deposits were deemed too uneconomic to mine (Roux *et al.,* 1989). However, in recent years the use of phosphate has increased due to the growing global demand for food and the rapid expansion of the agricultural sector in China, South-east Asia and Latin America (Ross, 2012). This upswing in demand has meant that since 2007, the price of phosphate rock concentrate increased from US$80 per tonne to a high of US$430 per tonne in 2008, resulting in the reappraisal of known marine deposits. Although the market has stabilised at a lower level of US$200 per tonne, the economics of marine phosphate mining have improved (www.unionresources.com.au).

One such project is the Sandpiper Deposit, located on the Namibian continental shelf, approximately 120km south-south-west of Walvis Bay (Figure 5.4). Namibian Marine Phosphate (Pty) Ltd (NMP) has obtained a Mining Licence for the Sandpiper Project, but Environmental Clearance was not yet granted by December 2012. The eastern boundary of the Mining Licence area is approximately 40-60 km off the coast (due west of Conception Bay). The water depths in the licence area range from 180-300 m. NMP are currently completing the Definitive Feasibility Study, working on a base case of:

- Recovery of phosphate sediment by dredging initially from water depths of up to 225 m, using a Trailing Suction Hopper Dredger (TSHD);
- Planned annual recovery volume of approximately 5.0 mt of phosphate-rich sea bed material to an initial thickness of 3m (potentially up to 6m), extracted from an area of up to $3km^2$;
- Transporting (by pumping) the sediments recovered by the dredger to shore by means of a sinker line pipeline to a buffer pond;
- Oversize screening of the slurry at the buffer pond site;
- Pumping the resultant slurry via a pipeline to the processing plant;
- Beneficiating (de-sliming, gravity separation of fine shells, attrition, washing and drying) the incoming material at a processing plant near Walvis Bay;
- Transfer of saleable product (approximately 3 mt rock phosphate concentrate) to the nearby port of Walvis Bay for loading onto suitable bulk carrier vessels for export or to other points of sale.

Production is expected to commence in the fourth quarter of 2013, with an expected mine life of 20 years (www.mining-technology.com).

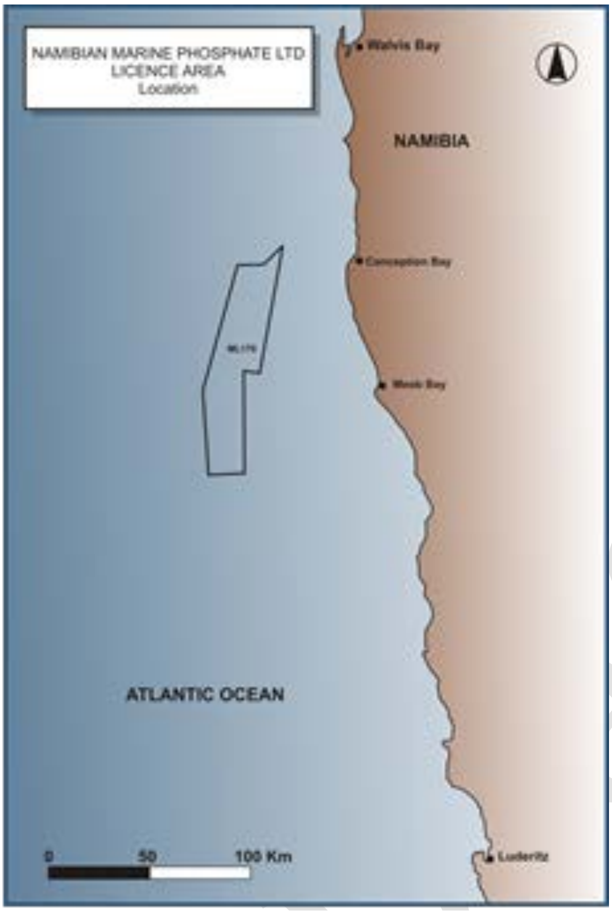

Figure 5.4: Location of the Sandpiper Phosphate Project (Mining Licence 170)
(www. unionresources.com.au)

A second Mining Licence for marine phosphates was granted to LL Namibia Phosphates (ML159) in October 2010. The company is currently carrying out exploration, sampling and testing. Gecko Mining has also shown interest in phosphate mining off the Namibian coast.

Salt

Two companies harvest salt near Walvis Bay and Swakopmund in Namibia. In South Africa, the main seawater salt producers are located at the mouth of the Sout Rivier (Plate 5.3) and Velddrif in the Western Cape, and near Port Elizabeth in the Eastern Cape. There are numerous small coastal salt works along the Angolan coast, some of which look as if they have been abandoned (GoogleEarth).

Plate 5.3: Cawood salt works at the mouth of the Sout Rivier in southern Namaqualand (www.geoscience.org.za)

Other

Other than the minerals discussed above, there are few other mineral resources occurring in the coastal zone in the BCLME region.

5.1.2 Future scenarios

Diamonds

After being hit particularly badly by the economic crisis of 2008, the diamond industry showed a remarkable recovery in 2011, which continued into 2012, albeit at a slightly lower level. This was primarily due to a sustained upward demand from the US, Japan and Europe, as well as increasing demand from new emerging markets such as China and India (Chamber of Mines, 2011, De Beers, 2011).

Coastal land-based mining is likely to recommence in the next 3 years at several existing mines: at Alexkor (after an intense 3 year exploration programme), at Namaqualand Mines (following the completion of the sale to TransHex) and at Elizabeth Bay (Namdeb), however, it is unlikely that any new large coastal mines will be developed in the foreseeable future. The two main marine mining operators – De Beers Marine and Namdeb – are both planning to redeploy their marine mining vessels (Namdeb, 2011, De Beers, 2011) within their existing sea concessions.

It is also likely that there will be renewed activity within the smaller boat-based concessions along the South African and Namibian coasts, with operators such as Namagroen, Pandamarine, Diamond Fields International, Sakawe/Samicor all re-entering the market as prices for rough diamonds improve.

All the above companies would continue operating within existing concessions, and there are unlikely to be any large new concessions being developed in the next 10 years. In the longer-term, there could be new mining interests along the Angolan coast, particularly near the mouth of the Congo River.

Heavy minerals

Namakwa Sands has an estimated life of mine of 25-30 years and unless there are unexpected market shocks, this mine will continue operating for this period. It is not known if the Tormin project will ever be developed, particularly as it only has a 3-5 year life of mine. There are few other large, economically-viable heavy minerals deposits on the South African portion of the BCLME. Several heavy mineral deposits have been investigated in the past along the Namibian coast, but they are not technically viable at present. With improved technology, there may be renewed interest in the deposits in the dune fields between Walvis Bay and Swakopmund and on the beaches north of the latter town. Little is known about the potential for heavy minerals on the Angolan coast.

Marine phosphates

Although there are no marine phosphate mining operations yet, there is a possibility that at least one, and possibly two dredging operations may commence within the next 10 years off the central Namibian coast. Again, little is known about the potential for marine phosphate mining in Angola.

5.1.3 Environmental Impacts

The environmental impacts of the various types of coastal and marine mining operations have been well documented through legally required environmental impact assessments (EIAs) and environmental management plans (RSA). There have also been a number of research studies on the impacts of mining on benthic fauna and flora, some of which were commissioned by the BCLME project (see Bibliography). The tables below list some of the larger-scale impacts arising from a) land-based coastal mining (diamonds and heavy minerals, and to a lesser extent, salt); b) near-shore, boat-based diving (diamonds); and c) deep-sea dredging (diamonds and phosphate). Since this is a Strategic Environmental Assessment, only the larger scale positive and negative impacts have been listed.

On-shore and beach mining

North of the Orange River mouth, mining technologies involving the construction of extensive seawalls parallel to the shore have enabled the recovery of diamondiferous gravels up to 20m below sea level and several hundred meters beyond the original shoreline. The massive seawalls, which may be up to 60m wide at their base and as long as 1km, are constructed using overburden material (sand, pebbles and boulders) relocated from beaches and dunes into the surf zone up to 200-500 m seaward of the high water mark, to allow diamonds to be extracted from the impounded bedrock (Plate 5.4).

Once the seawall has been constructed, diamonds are mined by ‘wet’ or ‘dry’ mining methods. Dry mining involves continuous dewatering of the void behind the seawall and the diamonds are mined using conventional dozers, front-end loaders and dump trucks. In Namibia, water containing sand and fine sediments is discharged into the sea resulting in beach accretion. In South Africa, the Mining and Petroleum Resources Development Act No 28 of 2002 (MPRDA) Regulations do not allow the fine slimes to be discharged to the sea and so the slimes material is discharged into a slimes dam located on land.

Plate 5.4: Old seawall at Alexkor being reworked by waves and currents

Once mining ceases, the seawalls are rapidly breached by wave action and, depending on their position and prevailing sea conditions, the area is left to re-form a new shoreline over a period of several years to decades.

Table 5.1.1: On-shore, land-based mining activities and impacts, including beach mining (diamonds, heavy minerals)

Typical construction and mining activities	Typical environmental impacts
• Vegetation clearance	• Loss and/or displacement of plant and animal spp
• Soil stripping	• Habitat loss or fragmentation
• Land disturbance	• Degradation of soil through disturbance, compaction, mixing, chemical contamination, etc
• Seawall construction	• Degradation of coastal and tidal zone habitat
• Road construction	• Wind erosion and dust
• Power and pipeline construction	• Noise and vibration
• Construction of camp and/or permanent village	• Increased economic activity (forward and backward linkages)
• Construction and operation of mine processing plant	• Increase in communicable diseases (e.g. HIV) due to influx of workers, job seekers and transport drivers
• Traffic	• Social disruption due to influx of workers and job seekers
• Generation of liquid and solid waste (Hazardous and non-hazardous)	• Increase in substance abuse
• Employment	• Increase in road hazards
• Income and revenue generation	• Pressure on local municipal services (waste removal, sewerage, roads, police, clinics etc)
• Purchasing and sub-contracting	• Improved skills development and training
• Mining waste (overburden, rock, tailings)	• Impacts (positive and negative) on housing market, schools depending on pre-development status
	• Visual impact from permanent scarring of landscape
	• Loss of future land use options e.g. tourism
	• Disposal of tailings to sea causes localized smothering
	• Impacts on oceanographic processes
	• *De facto* conservation in un-mined areas
	• Loss of cultural resources

Once mining ceases, there are usually a number of legacy effects, notably the creation of ‘ghost towns’ or towns with an unsustainable future, such as Hondeklipbaai, Kleinsee and Koingnaas at present. This in turn can cause a loss of social cohesion, often leading to substance abuse and poverty. Most of the larger mines have failed to keep up to date with concurrent rehabilitation and large parts of many of the coastal mines have not been rehabilitated (e.g. Alexkor, Namaqualand Mines, TransHex). This forecloses all options for some future beneficial use of the land and wind erosion of un-rehabilitated dumps and land continues unabated.

Near-shore diver-assisted mining

The impacts of individual near-shore (shallow water <30m) mining operations are relatively small compared to the land–based operations which are usually at a very large scale and the deep-sea marine dredging operations. However, cumulatively, with no controls, these operations can have a more significant impact. Diver-assisted operations are conducted either directly from the shore or from small vessels, as described below.

<u>Shore-Based Diver Mining</u>

Mining is conducted by diver-operated suction pumps directly from the shore to depths of 10 m in small bays. Operations typically consist of 2 – 3 divers and their assistants. Contractors usually attempt to locate heavy equipment as close to the sea as possible. Consequently, access to the water is sometimes achieved by blasting or mechanical damage in the supra-tidal and inter-tidal regions. A tractor modified to drive a rotary classifier and centripetal pump to which a 20 cm hose is attached, is parked in the inter-tidal area (Plate 5.5a). Divers, operating on hookahs from surface air supplies, guide the distal end of the suction hose into the gravel deposits, which are sucked up and delivered directly to the classifier. In order to reach the ore-deposits in the surf zone and beyond, kelp may be cut to allow easy movement of the suction hoses and airlines. Furthermore, in order to reach the deeper gravel deposits in potholes and gullies, large rocks and boulders usually need to be moved and these may be dragged from the gully at low tide by tractor and chains, and deposited at higher tidal levels. The classifier sorts the pumped material through a series of screens and concentrate is bagged and transported to a central mineral processing facility. Oversize tailings (+20 mm) are allowed to accumulate around the screening units (Plate 5.5b) and fines (-1.6 mm) are returned to the sea across the inter-tidal regions as a slurry (Penney et al., 2007).

Plate 5.5: a) Tractor and suction hoses; b) Mounds of oversize stones next to the classifier

Because of the tidal cycle and weather/sea state limitations, plants operate for less than 6 hours per day for an average of 5-6 days per month although longer individual periods may be workable, particularly in the summer months. Consequently each diver/tractor unit processes approximately 100 m^3 of gravel per year. The overall extent of the concessions mined is low, being estimated as <0.001% per year of the available area on the coast.

Vessel-Based Diver Mining

Vessel-based contractors work between 10-30m depth, targeting gullies and potholes in the wave-base regime. The operations differ from those of the shore-based divers only in the scale of operation and the complexity of the processing equipment. A typical boat-based operation consists of a 10 – 15 metre vessel with a 5 – 8 man crew, of which 2 – 3 are divers. The vessels are equipped with centrifugal pumps that operate one or two suction hoses, with the duration of their activities limited to daylight hours for 3 – 10 diving days per month. Some 20 – 22 metre vessels, offering surface decompression facilities and with 8 – 11 man crews, are also operational. These have the potential to work on a 24-hour basis for up to 21 days per month depending on sea and/or weather conditions. However, due the water depths involved, diver safety requires strict enforcement of decompression routines thereby limiting bottom-working time (Penney et al., 2007).

Similar to the shore-based operations divers guide the pump nozzles into gullies, potholes and basin areas to retrieve gravel. During the mining process, large boulders may be exposed or shifted by divers to access deeper gravel layers. These may be accumulated into underwater rock piles. The gravels are processed through a classifier mounted on the boat. Fine material washes directly back into the sea whilst the oversize fraction (>20mm) is either bagged and deposited in deeper water, or discharged directly overboard. Screened gravel, which may be partially jigged on board, is bagged and brought ashore for final processing (Penney et al., 2007).

Vessel-based diver-assisted mining generally operates only in exposed rocky shore areas where gravel is pumped from deeper gullies, or on the edges of sandy bays where the layer of overburden is relatively thin. For these areas mining rates (i.e. the amount of gravel removed in total from the sea floor) range from 50 – $450m^3$/month. It is estimated that in South Africa, <0.01% of the total 'a' concession area is mined per year.

Table 5.1.2: Near-shore diver-assisted mining activities and impacts (diamonds)

Typical construction and mining activities	Typical environmental impacts
• Employment	• Conflict with the rock lobster industry
• Skills development and training	• Litter and waste
• Opportunities for small companies and contractors	• Localised physical changes to the seabed (smothering of reef with discharged tailings and fines, creation of sediment plumes, destabilisation of gravel beds and removal of boulders

• Tracks	• Localised impacts on benthic communities
• Kelp cutting	• Localised short-term effects on kelp and associated ecosystem impacts.
• Suction pumping	• Poaching of marine resources (lobsters, mussels, reef fish)
• Discharge of fines overboard	• Localised pollution from boats (hydrocarbons, anti-fouling paint etc
• Movement of boulders	• Low level of income for local communities
• Generation of wastes (pipes, metal, tyres, litter, plastic, etc)	
• Employment	
• Income and revenue generation	
• Purchasing and sub-contracting	
• Small camps	
• Boat servicing	

Research studies conducted during the Phase 1 BCLME study by Pisces Environmental Services (2007) concluded that in the context of the wide distribution range of the two kelp species and the effects of large-scale natural disturbances characteristic of the Benguela ecosystem, cutting of kelp and discharge of sediments by diamond divers is insignificant, even on a cumulative scale. Of far greater concern are the continual sediment inputs through seawall erosion from coastal diamond-mining operations and increasing discharges of sediments from land-based processing plants in southern Namibia.

Marine dredging

The prospecting and mining vessels currently used in southern African marine diamond recovery range from 1,000 – 6,000 gross registered tonnes attaining lengths of 150 m. These operate as semi-mobile platforms on a dynamic positioning system, or self-mooring systems commonly using three to four anchors spread on the seabed at the end of wire ropes or chains on positioning winches, to enable the vessels to locate themselves precisely over a mining 'block' of up to 400 m x 400 m. These ships are fully self-contained mining units, with a processing facility on board, and can operate on a 24-hour basis through 11 months of the year. Typically 1 month of each year is used for major servicing of the ship and mining equipment in the home port, usually Cape Town (Penney et al., 2007).

A variety of methods are used to mine marine diamond resources in water depths >30 m, which may be split into mid-water operations (down to a depth of ~75 m) and deep-water operations (currently down to a depth of 150 m).

A recent advancement of Trailing Suction Hopper Dredges (TSHD) has made it possible to dredge unconsolidated sediments at depths of up to 131 m below mean sea level, this approach is now being applied in offshore areas that are both uneconomical and inaccessible to the current mining fleet due to the overburden layer exceeding ~5 m thickness (Pisces Environmental Services 2004) (Figure 5.5).

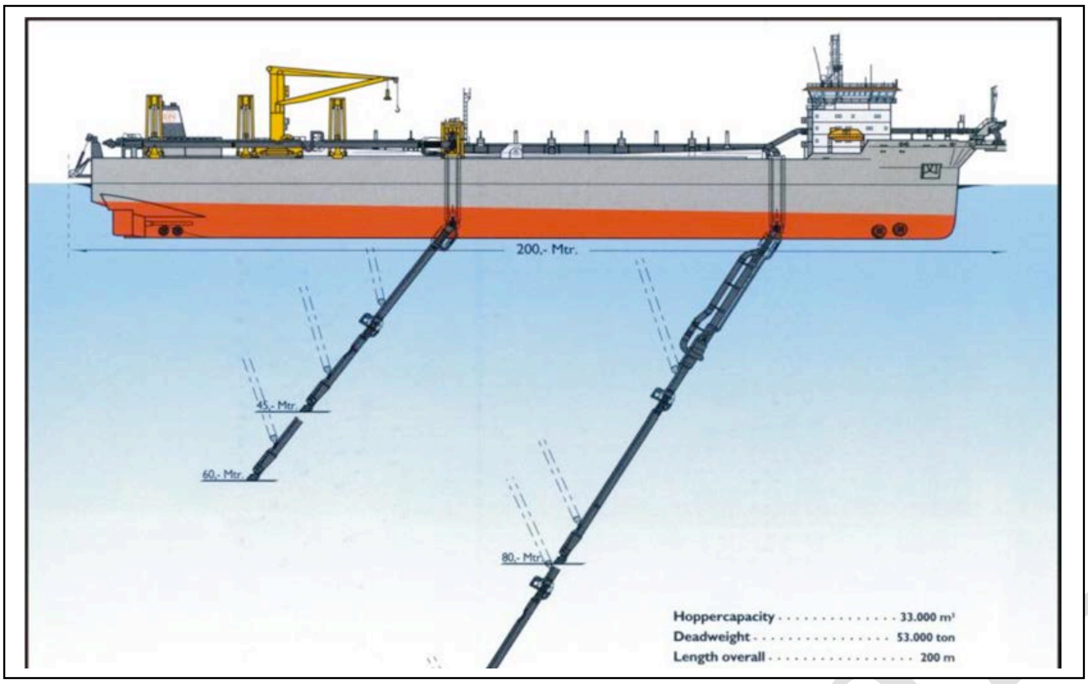

Figure 5.5: Schematic diagram of the trailing suction hopper dredger, *Vasco da Gama*, used in the Atlantic 1 MLA (from Penney et al., 1999).

Shipboard Diamond Gravel Processing

The deepwater mining methods described above remove unconsolidated seabed sediments down to, and including, the diamond gravel ore body. The resulting sediment slurry is pumped to the surface and discharged onto a series of screens which separate the oversize and undersize fractions. The oversize boulders and undersize fine tailings are immediately discarded overboard, with almost 90% of the material pumped to the surface being returned directly to the sea (Figure 5.6). Most of this sediment settles back in and around the mining area, although care is obviously taken to prevent deposition of disposed tailings onto un-mined target areas.

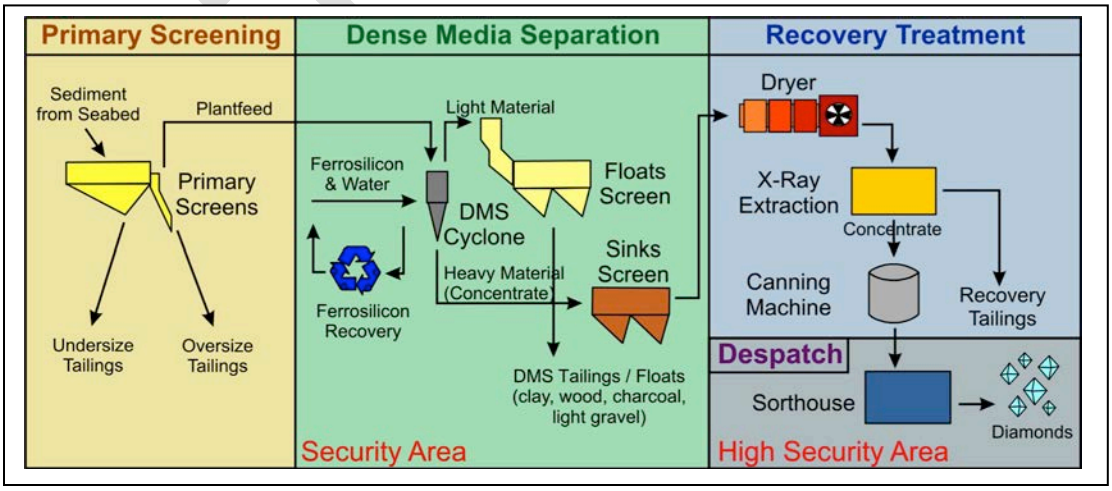

Figure 5.6: Flowchart of shipboard marine diamond gravel processing operations (From Penney et al., 1999).

The gravel fraction of interest is mixed with a high-density ferrosilicon slurry and pumped under pressure into a Dense Medium Separation (DMS) plant. Low-density materials (floats) are separated from the concentrated plant feed and discarded overboard (Figure 5.6). Most of the ferrosilicon is magnetically recovered for re-use in the DMS plant.

The remaining high-density fraction is dried and passed through an X-ray sorting machine to separate the diamonds, which fluoresce under X-ray illumination. Non-fluorescent material is discarded overboard and the fluorescent fraction is either hand sorted for diamonds on board the mining vessel or automatically sealed in cans for transport to shore and final hand sorting.

Of the material pumped to the surface, 99.9% is returned directly to the sea. Re-mining of an area occurs only when the initial coverage of a block by the mining tool was insufficient.

Fine tailings can remain in suspension for long periods forming plumes that are advected away from the mining vessel by ambient currents. Most of the silt sinks rapidly (minutes) during the initial convective descent phase; entrainment of seawater resulting in dilution of both the dissolved and particulate constituents of the discharge. Ultimately the density of the diluted discharge becomes neutrally buoyant, with the remaining particulate matter spreading and settling further through passive diffusion (hours) (Clark, Meyer et al. 1999).

Although the plumes may extend several kilometres, the potential impact on phytoplankton communities through reduction of light, nutrient enrichment, remobilisation of contaminants, and deep oxygen consumption through decomposition of silt particles during descent, is generally very limited and localised. The extent of the impact of the plume depends largely on the proportions of silts and clays in the targeted sediment, and the sea surface conditions during disposal. Measurements made by Clark, Meyer et al. (1999) of dissolved nutrient concentrations (NH_4, PO_4, NO_3 and NO_2) in the tailings discharge were found to be within the specified limits set by the "Water Quality Guidelines for the South African Coastal Zone". Rapid descent and dilution of dissolved nutrients and contaminants in the convective descent and passive dispersion phases resulted in ammonium concentrations declining to below detection levels within an hour of release. There was no evidence of the release of NO_3 and NO_2 from interstitial waters as is to be expected from anoxic sediments. Due to their low solubility in seawater, elevated concentrations of trace elements (Cd, Co, Cr, Mn and Pb) have, however, been recorded in the tailings plumes; those of Cd, Cr, Cu and Zn breaching the recommended water quality guidelines. Evidence suggests that pesticide levels resulting from re-suspended biogenic muds are unlikely to exceed recommended guideline levels. Remobilisation and subsequent uptake of contaminants by marine organisms has important implications for bioaccumulation down the food chain. Assessments of the potential oxygen consumption through decomposition of silt particles during descent have indicated that rates are low and no measurable impacts on the typical bottom water concentrations are expected (Clark, Meyer et al. 1999).

Ferrosilicon loss in the tailings has been reduced through the introduction of vertical impact crushers and sophisticated recovery systems, but in 1995, it was calculated that losses averaged of 127 t annually. In areas with iron deficiency, this could potentially increase primary productivity and alter the phytoplankton community structure (Clark, Meyer et al. 1999).

Table 5.1.3 shows the main impacts that result from deep-water marine mining for both diamonds and phosphates, although the latter are merely postulated at this stage as no mining has occurred in the BCLME area yet.

Table 5.1.3: Deep-sea marine mining and dredging activities and impacts (diamonds and phosphate) (Source: de Beers EMPR, 1999)

Typical prospecting and mining activities	Typical environmental impacts
Seismic surveying - Acoustic pulses from towfish & exploding air bubbles from airgun	Vibration or noise disturbance of marine fish & mammals
Sampling & mining - Sea bed removal	Disturbance of benthic communities & habitat
	Destruction of geological record
	Destruction of wrecks
Use of ferrosilicon in treatment process - discarding sediment containing ferrosilicon overboard	Increased primary productivity
Disposal of all tailings overboard (water column) - Remobilisation of metals/pesticides present in the tailings	Pollution of the sea by metals & pesticides
Disposal of all tailings overboard (seabed) - settling of tailings on seabed	Smothering of benthic invertebrates
	Reorganisation of sediment structures
Typical activities relating to vessels at sea	
Presence of vessels - physical presence in an area	Potential exclusion of alternative resource use (e.g. fisheries, oil exploration/exploitation)
Refuelling at sea - oil spill	Pollution of the sea by diesel
Acoustic positioning - Deployment of concrete blocks / polypropylene rope on seabed	Obstacles
Noise emission of particular frequencies	Disturbance of fish & marine mammals
Air conditioning & refrigeration systems - R22 refrigerant use in systems	Ozone depletion
Incidental loss of equipment - Physical nature & composition of lost equipment	Obstacles
Hull anti-fouling paint containing TBT - Release of TBT	Marine pollution - toxins
Sewage disposal - Release of sewage	Increased nutrient load to the system
Handling/storage of scrap metal & cans - separation of recyclable waste	Recycling of materials
Handling/storage of toner & ink cartridges - separation of re-usable containers	Re-use of material
Handling/storage of paper & cardboard - Separation of recyclable waste	Recycling of materials
Electricity generation - Gas oil consumption	Depletion of non-renewable resource
- Emission of NOx, SOx, CO2, Volatile Organic Carbons (VOCs) from oil	Air pollution
Water consumption - Use of engine heat for evaporation of seawater to freshwater	Efficient use of resources
- Utilisation of fresh water resources from shore	Depletion of limited natural resource

Paper consumption	Depletion of limited natural resources (water/wood)
Onshore logistical support	
Control & use of aircraft - Noise & visual intrusion	Disturbance of estuarine birds
Disposal/recycling of used oil	Recycling of materials
Disposal/recycling of scrap metal & cans	Recycling of materials
Disposal/recycling of toner & ink cartridges	Re-use of material
Disposal/recycling of paper & cardboard	Recycling of materials
Paper consumption	Depletion of limited natural resources (water/wood)
Emergencies	
Grounding / sinking of vessel - Uncontrolled spills of hazardous & other substances	Marine pollution
Vessel collision - Uncontrolled spills of hazardous & other substances	Marine pollution
Socio-economic aspects	
Employment - Provision of work & employee training	Boosts South African economy Development of skills
Taxes / royalties - Payment of taxes & royalties	Contribution to national economy
Use of Western Cape harbours - Payment of fees	Financial contribution to harbours
Use of Port Nolloth harbour - Upgrades to the jetty by De Beers Marine	Improved harbour facilities
Use of Port Nolloth as a logistics base - Local employment & purchasing of local goods & services - Upgrading of warehouse & stores area	Boosts local economy Enhancement of infrastructure
Use of Pentow launch from Port Nolloth - Local employment	Boosts local economy
Collection point for used oil generated in Port Nolloth for recycling	Recycling of materials Prevention of oil pollution through improved waste management practices
Encouraging the development of SME's - Selling scrap metal to local SME & Servicing vehicles through local SME	Boosts local economy Boosts local economy
Research & design of prospecting, mining & metallurgical systems - Development of technology	Technological advancements
Sponsorships of research, education & community projects - Creation of opportunities for research & education	Improved environmental knowledge/awareness of the region

The mining process removes unconsolidated sediments, resulting in the destruction of benthic fauna, and modification of the benthic habitat in the mining path and in adjacent areas where disturbed sediments are re-deposited. This causes direct mortality of organisms through the dredging and discharging process, potential smothering of organisms affected by the fallout, and possible aggravation of oligoxic conditions causing migration or even death. Consequently, a significant change in abundance and diversity of benthos has been observed in mined areas and their immediate vicinity. Substantial re-stratification of sediments occurs thereby influencing the rate of recolonisation as well as the structure of the developing benthic community. The recovery rate of a perturbed area has been estimated to take as long as eight years, but habitat modifications may be permanent resulting in a persistent environmental impact and change in the associated communities. This may potentially affect the food chain and have important implications for the distribution and abundance of other marine organisms such as rock lobsters and fish. However, without baseline data on the natural variability and patchiness in benthic community structure with sediment type, depth, and transient changes in water quality, it has not been possible to provide a cumulative assessment of mining damage. Furthermore, spatial heterogeneity of benthic communities has precluded the application of results across wider areas.

Box 5.1: The case for caution about phosphate dredging

The environmental impacts of mining the seabed are poorly known. Thus, the potential impacts of dredging loose phosphate deposits needs to be thoroughly investigated bearing in mind the following: -

- Sea bed mining (like dredge fishing activities) is likely to transform benthic habitats (including shelf slopes and seamounts). These habitats have not been studied sufficiently to understand what the degree of damage could be but many seamounts support endemic species and little known biodiversity that can easily be eliminated by mining activities (Sink 2004).

- Shannon and O'Toole (1999) state that chemical processes that take place within interstitial water bodies and the interface between the sea bed and the overlying water are likely to play an important role in the regeneration of essential nutrients that kickstart the food chains that mobilize the marine food chains.

- Phosphates are vital to life. They form a component of genetic material and energy carrying molecules such as ATP. It is found in phospholipids, cell membranes, bones and teeth. A simplistic explanation of part of the phosphate cycle is explained as follows:
    - Bioavailable Phosphate comes from either the weathering of primary mineral (Apatite); the remineralisation of organic Phosphate by bacteria; or the dissolution of secondary minerals (e.g. Phosphorite).
    - Excretions, death and decay release organic phosphates which are reduced by bacteria to inorganic phosphates. The released Phosphate compounds are taken up by phytoplankton and passed along the food chain. The bio-availability of Phosphates for phytoplankton and other primary producers in the ocean depends on (inter-alia):- p;, the C:P ratio, and; the concentration of sulphates.
    - Acid fog has the potential to drive Phosphates into solution through anion exchange; thus increasing primary production and consequently enhancing the chances of eutrophication and the incidence of HABs.

The fish fauna of the west coast of South Africa and Namibia has a low diversity and contains few endemic species. Most species are widespread and to some extent migratory and are thus able to escape from oligoxic incursions as well as disturbance by mining tools. Although baseline knowledge exists of the abundance and distribution of the commercially important species in the areas of mining activity (hake, monkfish, sole, kingklip, and rock lobster), attempts to quantify these on a sufficiently fine scale to determine the impacts of offshore mining have not been attempted.

Rock lobster and sole are the most restricted in their distributions and migratory capacity and thus the most likely to be at risk. The main spawning areas of the commercially important fish species are primarily north (<25°S) of current mining activities in Namibia, and south (St Helena Bay) of activities in South Africa. The shallow shelf region between St Helena Bay and the Olifants River appears to be utilised as recruitment grounds by most of these species. The principle risk of offshore mining activities to rock lobster is the aggravation of oxygen poor conditions and the disruption of seasonal offshore migrations as part of their breeding and moulting cycles. Most of the rock lobster fishing activities occur within 5 nautical miles of the coast; overlap with offshore mining is thus limited. However, information on rock lobster behaviour in deeper water and the role of migrations is lacking and should be researched further before conclusions concerning the impact of mining can be made.

Desktop studies have identified the main potential impact of mining on fish to be on the breeding success rather than on the adult stocks themselves. The impact is thought to be greatest in the water column below the thermocline where the vulnerable early life-history stages may be negatively influenced by oligoxic conditions in the suspended sediment plumes. No quantitative data are available, however, and the coincidence between the sediment plume and fish egg and larval distributions needs to be investigated further.

The primary sources of noise associated with mining operations are the sounds caused by equipment and machinery, and sonar and seismic equipment. The latter frequencies overlap with the spectrum of frequencies used by marine mammals to communicate and have the potential to cause injury and discomfort.

Some crew changes involve aircraft flying low over wetlands, which has been found to cause disruption to waterbirds. Reactions to fixed-wing aircraft and helicopters vary between bird species but foraging, roosting and breeding activities are generally negatively affected, potentially reducing reproductive success. Although no similar studies have been conducted on the effects of low flying helicopters on seabird and seal populations on offshore islands, short-term disturbances are to be expected.

5.2. Oil and gas exploration and production

5.2.1. Current extent

Angola is currently the only BCLME country producing oil, while South Africa produces gas and Namibia is in the process of exploring for both oil and gas.

Angola is Africa's third largest oil producer behind Nigeria and Libya, with proven oil reserves of 13.5 billion barrels at the end of 2010, equivalent to 19.9 years of current production and 0.97 % of the world's reserves (2011 BP Statistical Energy Survey). Angola produced an average of 1,851 thousand barrels of crude oil per day in 2010, of which more than 90% is exported, primarily to China and the USA. Angola's oil and oil derivatives industry accounts for 91.92% of total exports. Petroleum and petroleum products generated nearly $9.7 billion in State revenues in 2004.

Offshore Angola is recognised as a world-class area for oil exploration and production, but it currently flares the majority of its natural gas. However, plans are underway to convert natural gas into liquefied natural gas (LNG).

The majority of the country's crude oil is produced offshore in Block Zero, located in the northern Cabinda province. Crude reserves are also located onshore around the city of Soyo, offshore in the Kwanza Basin north of Luanda, and offshore of the northern coast. Significant discoveries have been made in Blocks 14, 15, 17 and 18 since the mid 1990s. Companies are focusing on ways to reduce the costs and improve the cost-efficiency of producing from the high risk deep-water areas[22].

[22] (http: //www.mbendi.com/indy/oilg/af/an/p0005.htm#5, accessed 17 September 2012

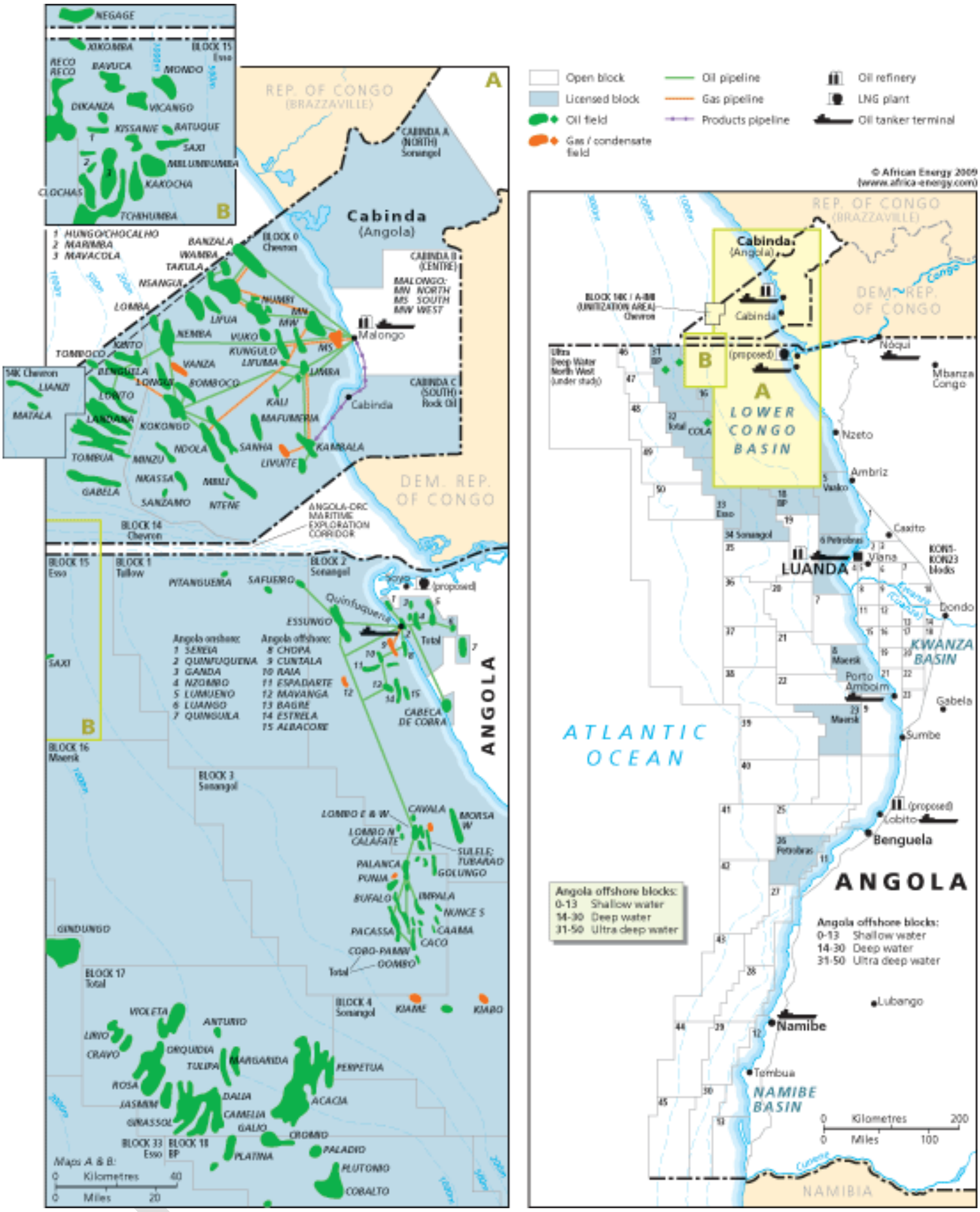

Figure 5.7: Angola's oilfields and export terminals (source http://secure79.elinuxservers.com/~ae/html/Public/map_library/south/angola/09_Angola_oil_fields_terminals.html - accessed 20 November 2012)

South Africa remains a largely unexplored region in which there have been only modest, mainly gas, discoveries to date. The country's south coast is the only producing area, with gas from PetroSA's FA platform being piped ~80 km onshore to a Gas-to-Liquids (GTL) plant near Mossel Bay. The existing producing fields are now very close to their end of life and PetroSA is actively looking to develop further reserves starting with the subsea development of the FO field. Canadian Natural Resources holds a promising offshore block in the area which is thought to have potential for a significant oil discovery. The whole area is quite a challenging development environment due to strong currents but much of the region is in reasonably shallow water.

A more promising area for gas is the Orange River Basin, situated between South African and Namibia. Forest Oil has a commercial gas discovery in about 100 m of water about 100 km from the coast and is currently working on gas market development activities prior to proceeding with the field development. Tullow Oil's Kudu gas field, situated just north of the border in Namibia, is another commercial discovery in the area that is awaiting a development decision.

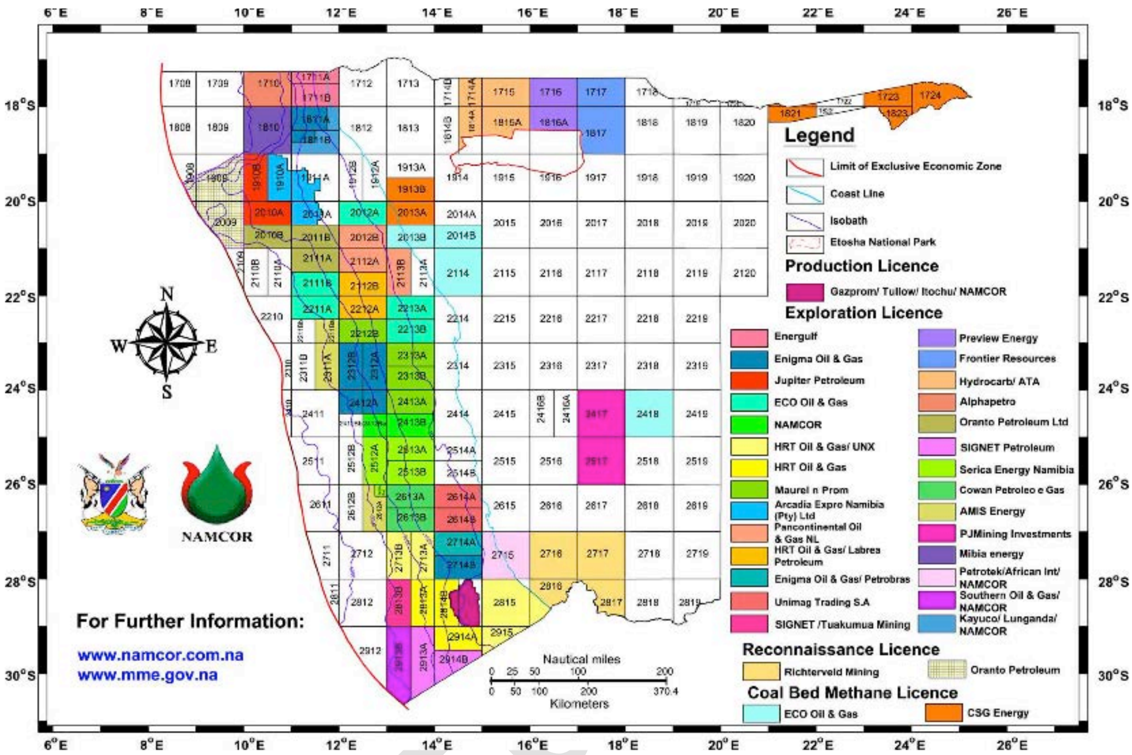

Figure 5.8: Hydrocarbon licences in Namibia in 2012 (source www.mme.gov.na, accessed 20 November 2012)

A number of exploration blocks operated by PetroSA, Forest Oil and BHP Billiton hold potential for gas and oil discoveries. Exploration on these blocks has been substantially delayed by the changeover in the South African mineral rights regime and the need for companies to convert or reapply for licences - however the rights are now being finalised and exploration activity is likely to pick up in the near future[23].

[23] www.saoga.org.za, accessed 26 September 2012.

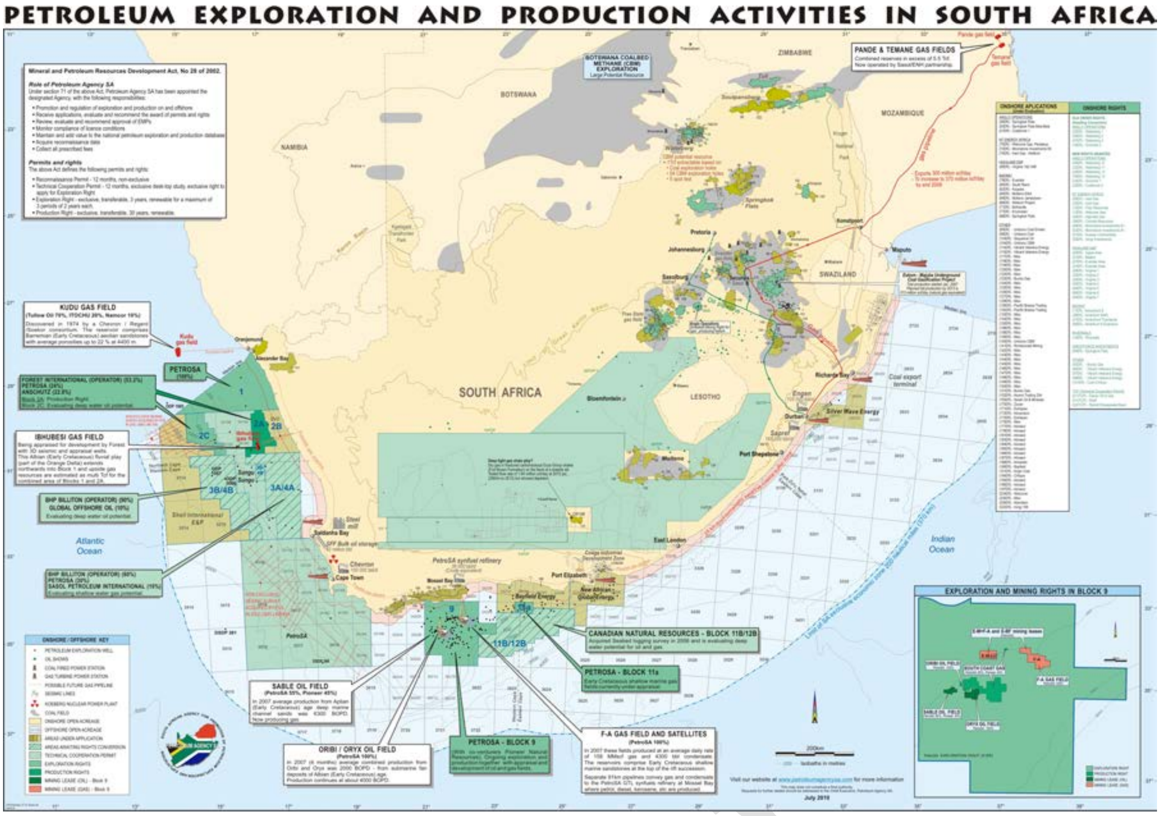

Figure 5.9: Hydrocarbon licences in South Africa (source www.cef.org.za, accessed 20 November 2012).

5.2.2. Future scenarios

On the demand side, the principal factor is the large and growing energy demand from especially China, India, and other emerging economies—driven by their rapid growth (ADB 2009). Because most of the increased demand in global energy markets is a derived demand of these countries, and given the huge scope that exists for these economies to continue growing, there is a cautious expectation that energy prices will rise again in the medium term, and that exploration and production will expand.

5.2.3. Environmental Impacts

Despite the challenges and issues involved, an oil and gas resource boom can, under the right circumstances, be an important catalyst for growth and development. The often-referred-to 'natural resource curse' can be avoided with the right institutions and policies. Several countries in Africa have demonstrated this and it is hoped that countries have learned hard lessons from past resource booms, and, in future, will pursue strategies and policies that will allow them to fully reap the benefits of their natural resource wealth.

On the other hand, there is considerable evidence that inappropriate management of this sector can cause misery amongst local communities and catastrophic effects on the biophysical environment. The Niger Delta 'case study' is a sober reminder of how badly things can go wrong if safeguards and governance are inadequate.

Table 5.2.1: Direct and indirect impacts of the oil and gas industry

<u>Main Exploration, Planning and Design Activities</u>

- Choice of development solutions (e.g. oil or gas well locations)

- Pipeline route selection
- Seismic surveys

Main Impacts of Exploration, Planning and Design on the natural environment

The following impacts on the natural environment need to be taken into consideration during the exploration, planning and design stage:

- Noise and sound waves from seismic surveys
- Disturbance of marine mammals and seabirds from increased vessel and helicopter activities
- Waste and effluent disposal from exploration vessels
- Disturbance of the seafloor by anchors
- Risks of accidental oil spillage
- Risk of blow-out
- Drilling waste disposal

Main Construction Activities*

- Well drilling and logging from drilling rig or semi-submersible unit
- Well testing and flaring (if necessary)
- Pipeline laying
- Construction of pipeline landfall facilities
- Supply base/port facilities
- Land-based contractor's camp, yard and workshops
- Helicopter operations
- Service vessel activity
- Waste management
- Disposal of produced water

Main Impacts of Construction on the natural environment

- Impacts on benthic fauna from the discharge of drilling mud and drill cuttings
- Impacts on fish and fisheries due to the discharge of produced water, sewage, galley wastes, ship/rig runoff etc**
- Impacts on seabirds and marine life (especially crustaceans) from accidental oil spills
- Disturbance of marine mammals and seabirds due to increased vessel and helicopter activity
- Temporary and locally permanent loss of habitat for near shore and beach organisms during the construction of pipeline land fall structures
- Possible introduction of alien species through discharge of ballast water and vessel hulls
- Emission of CO_2, NOx, SOx, VOCs from flares, exhaust emissions with indirect impacts on the natural environment as a result of climate change, acid rain and nitrogen fall-out
- Illegal disposal of hazardous and industrial waste at sea resulting in pollution and ingestion by marine fauna leading to chronic and acute effects and mortalities
- Fishing exclusion zones around

well development facilities could place pressure on other fishing areas

- Bioaccumulation of heavy metals in seabirds, mammals, fish and crustaceans with impacts on species physiology, food chain functioning and possible toxic health effects in humans

Main Operational Activities (platforms or sub-sea manifolds)

- Presence of a production platform, with:
  - Flare gas and recovery systems
  - Power generation plant
  - Flow lines and return lines
  - Accommodation for platform staff
  - Waste management system
  - Sewage plant
  - Helicopter operations
  - Service and supply vessels
  - Disposal of produced water and other process chemicals
  - CO_2 injection and storage

OR

- Remote operation of sub-sea manifolds, with:
  - Flow lines, umbilicals control lines, gas/oil pipeline, corrosion inhibitor pipelines
  - Pipeline landfall structures
  - Land-based gas conditioning plant
  - Effluent and waste disposal

Main Impacts of Offshore Oil and Gas Production on the natural environment

- Impacts on fish and fisheries due to the discharge of produced water, sewage, galley wastes, ship/platform runoff etc**
- Impacts on seabirds and marine life (especially crustaceans) from accidental oil spills, blow outs
- Disturbance of marine mammals and seabirds due to helicopter activity
- Emission of CO_2, NOx, SOx, VOCs from flares, exhaust emissions with indirect impacts on the natural environment as a result of climate change, acid rain and nitrogen fall-out etc
- Illegal disposal of hazardous and industrial waste at sea resulting in pollution and ingestion by marine fauna leading to chronic and acute effects and mortalities
- Fishing exclusion zones around well development facilities and platforms could place pressure on other fishing areas
- Bioaccumulation of heavy metals in seabirds, mammals, fish and crustaceans with impacts on species physiology, food chain functioning and possible toxic health effects in humans

Main Decommissioning Activities

- Abandonment/removal of all sub-sea structures
- Removal of platform
- Decommissioning of wells
- Demolition and removal of land-

Main Impacts of Oil and Gas Decommissioning on the natural environment

- Return of species to area
- Return of fishing boats to area
- Improvement in water quality
- Risk of oil and other

based structures	contamination during rig stripping, well closure and rig removal

**all activities associated with oil and gas field development up to the point of delivery to a refinery, LNG plant or ship or power station.*
*** the main pollutants are: BTEX, naphthalene, poly-aromatic hydrocarbons (PAHs), phenols, aliphatic hydrocarbons, heavy metals, process chemicals e.g. flocculants, corrosion and hydrate inhibitors and organic pollutants, etc.*

Cumulative impacts and linkages

Wherever the oil and gas industry has been established, it has transformed or significantly changed the economy of a country – Angola being a prime example. This sector stimulates a host of other economic activities that attracts multiple investments from associated industries and service providers. Whilst this should be welcomed in a region suffering from unemployment and poverty, economic distortions of 'boom times' can be very disruptive and difficult to manage. Inevitably, a range of cumulative impacts occur, including:

- Increased pollution – from ships, harbour facilities, and maritime accidents;
- Urban migration, which on the one hand can have positive impacts (e.g. support of and access to social infrastructure), but on the other lead to an escalation of crime, spread of STDs and other societal ills;
- Development and increasing economic activities, combined with urbanisation generally generate greater demand for land and resources, leading to a host of cumulative impacts, including land-take and habitat loss, increased traffic (with associated impacts such as pollution, accidents, etc.);
- Institutions (e.g. environment authorities) are often already under stress, and the rapid development of a new sector where it was previously absent (or fast growth), significantly adds to administrative burdens. Failure to upgrade institutions inevitably leads to circumvention of bureaucracy (including corruption) and inadequate implementation of safeguard tools.

5.3. Coastal urbanisation, recreation and tourism

5.3.1. Current extent

The level of coastal urban development, recreation and tourism along the BCLME coastline depends on a number of key factors: climate, scenic value, landscape integrity, accessibility, safety and security, and availability of services.

South coast (Port Elizabeth to Cape Town)

The coastal strip from Port Elizabeth (PE) to Cape Town is the most densely developed part of the BCLME coastline, with two cities (PE and Cape Town), six major towns and over 66 small towns, villages and resort developments, giving an approximate density of one settlement every 11 km of coastline (Appendix D). This figure however masks the fact that most of the settlements extend in a linear fashion along the coast to maximize sea views and therefore the proportion of developed area to coastline will be high. Most of the resort developments comprise holiday homes, but there are several golf course developments as well, although some of these have failed for economic reasons.

Tourist activities along this strip comprise angling, sightseeing, whale viewing, hiking (there are several popular coastal hiking trails (e.g. Whale Trail, Otter Trail), golf, water sports, beaches and camping.

West coast (Cape Town to Luanda)

Compared to the south coast, southern Africa's south-western coast is relatively sparsely populated (Figure 5.10) due to a combination of the aridity of the climate, topography and access restrictions due to mining or conservation. There are three exceptions: in the extreme south-west, where there is an almost continuous strip of coastal development from Cape Town north to Velddrif (approx 150 km); along the 40 km section of coast between Walvis Bay and Swakopmund; and around Luanda in Angola. These metropolitan areas are all experiencing growth, with Luanda expecting a 47-50% growth in the next decade[24]. All other cities and towns are also growing, albeit at relatively slower rates (7% Saldanha Bay, 5.35% Walvis Bay, 1.61% Cape Town).

Other than the main urban centres discussed above, the density of coastal development decreases as one moves northwards from the Cape up to Angola, reflecting the increasingly arid conditions. There are approximately 28 villages and resorts along the South African west coast (density approximately one every 23 km). In Namibia, there are only four towns and two villages along the entire 1,570 km of coast, giving a density of one every 260 km. This low density of settlement persists into southern Angola, but as one moves northwards, and as the environment becomes less arid, the density increases. Along the approximately 1,060 km coastline between the Kunene River mouth and Luanda, there are 5 towns with a population over 50,000, three smaller towns (population between 10,000 and 50,000) and more than 20 small villages, giving a density of approximately one settlement every 37 km.

The main tourist activities along the coast include angling, sightseeing, water sports (limited to a few sheltered areas), seal and bird watching. Parts of the Namibian and Angolan coasts are popular as 4x4 routes.

[24] http://www.unhabitat.org/documents/SOAC10/SOAC-PR1-en.pdf, accessed 4 October 2012.

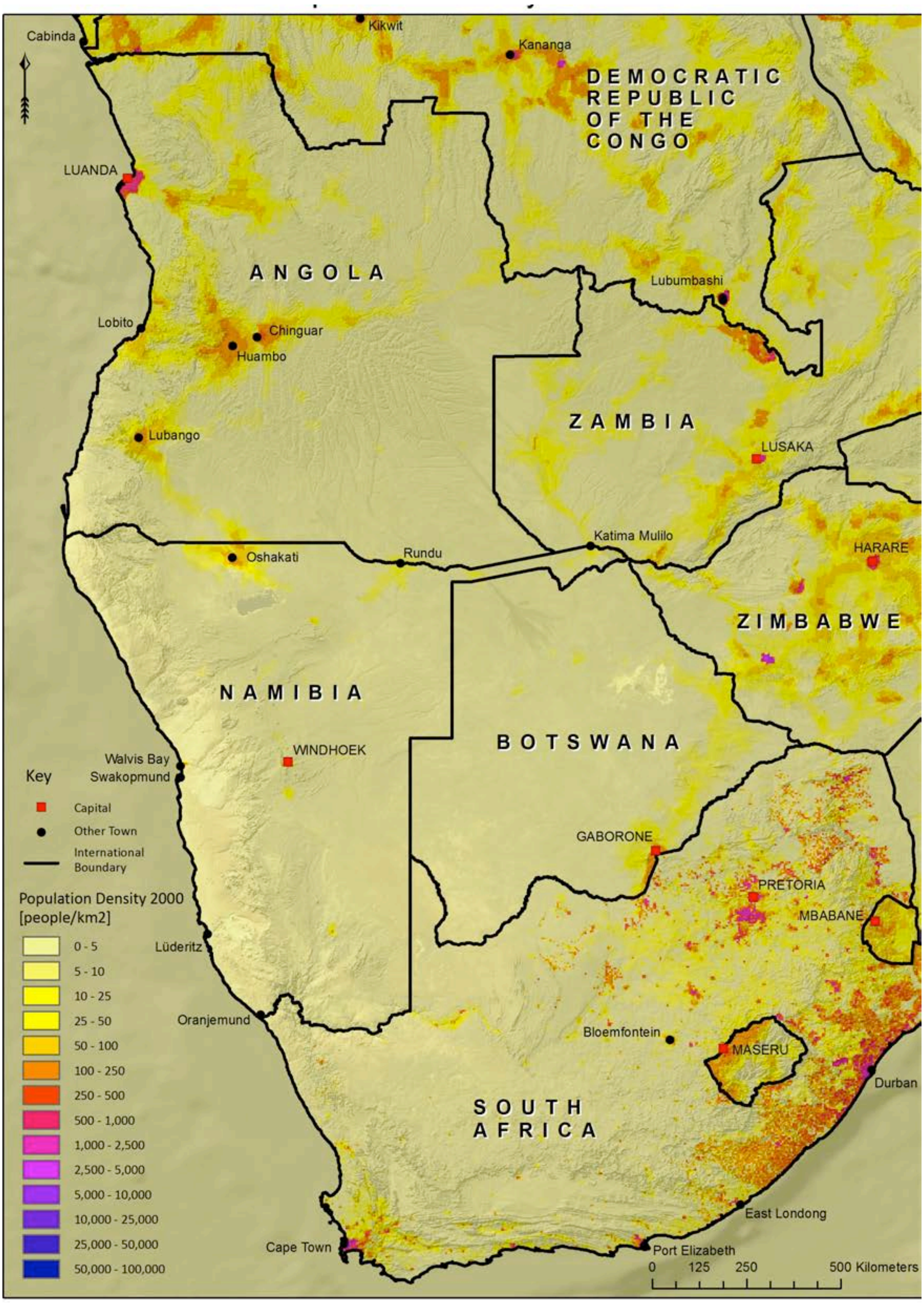

Figure 5.10: Main towns and population densities in southern Africa.

5.3.2. Future scenarios

As noted above, it is expected that all the towns and cities will grow, but at different rates. Areas likely to show the fastest growth and thus an escalation of development activities are Luanda, Saldanha Bay and Walvis Bay-Swakopmund. Once the Benguela railway has been upgraded and restored to full operation, it is likely that the port town of Lobito will also see rapid growth. If the proposed Cape Fria harbour goes ahead, it is likely that a new town will develop around this new port.

With Angola becoming rapidly more accessible for tourists, there are likely to be many more tourist operations opening up along this spectacular coastline.

All beaches around the Cape Peninsula (Clifton, Camps Bay, Llandudno, Hout Bay, Noordhoek, Kommetlie, Scarborough, Simons Town, Glencairn and Fishhoek) and the remaining coast to Cape Aghulus are already important growth nodes and are likely to continue to expand into the future (with the exception of localities like Llundudno which is fully developed and surrounded by extensive and steep rocky areas). Also, eco-tourism opportunities could increase with improved conservation efforts. For example, the African Penguin colony on the Cape Peninsula is now on the international (and domestic) tourists' "must see" list (Du Toit *et al*, 2003).

5.3.3. Environmental Impacts

Table 5.3.1: Direct and indirect impacts of coastal development, recreation and tourism.

Main Construction Activities

- Vegetation clearance
- Topsoil stripping
- Construction and/or upgrading of roads
- Fence and wall construction
- Contractor's camp, yards and workshops
- Waste disposal
- Bulk earthworks
- Installation of bulk services (water, sewerage, power, telecoms)
- Site development and building construction
- Transportation of all raw materials to site
- Construction traffic
- Labour force

Main Impacts of Construction on the natural environment

- Temporary and permanent loss of habitat
- Road collisions with animals, birds
- Dust smothering of vegetation
- Habitat fragmentation
- Local loss of species
- Loss of ecological corridors
- Loss of access to ecological goods and services by local communities with resultant impacts on livelihoods
- Indirect impacts on the natural environment due to resettlement of local communities

Main Operational Activities

- High water consumption
- Increased stormwater runoff, sewage volumes and return flows
- Application of fertilisers, pesticides, herbicides and fungicides in gardens, parks, golf courses etc
- Groundwater abstraction
- Greater energy requirements
- Increased traffic (cars and boats) and noise
- Landscaping with alien species and irrigation
- Increased waste production.

Main Impacts of Urban Developments, recreation and tourism on the natural environment

- Direct loss of habitat and/or habitat transformation and fragmentation
- Direct loss of species in the area due to loss of habitat, road and powerline collisions, offroad driving, over-utilisation (e.g. fish, shellfish, bait)
- Indirect loss of habitat through water pollution, dust smothering, air pollution, soil contamination, noise.
- Disturbance to wildlife, particularly ground-nesting birds, cetaceans, fish, sensitive birdlife (e.g. flamingo to low

- flying aircraft).
- Alien species invasion (plants, birds, pets, pests, vermin, water weeds).
- Landscape scarring – e.g. through offroad driving.

Possible cumulative impacts

Coastal cities and towns present a number of economic and lifestyle opportunities to a great variety of people, both locals and visitors. In almost all cases, 'pull' factors such as economic drivers (e.g. ports, fisheries, mining, industrial development, oil and gas, tourism) will be the main cause of growth, but other drivers include 'lifestyle investments'. Push factors that contribute to growth of towns are mostly a lack of opportunities (e.g. inadequate rural development, failing agriculture) in inland areas, whilst congestion and/or inefficiency of other SADC ports and safety concerns in the Indian Ocean Region, may also be a 'push' factor for port development on the west coast. A historical 'push' factor in Angola was the civil war in that country, which resulted in one of the greatest urban migration phenomena in recent history in the region. This has been the single most important reason for the phenomenal growth of Luanda and other coastal towns. As noted earlier, coastal development nodes provide a critical mass of economic activities and social infrastructure that attracts multiple investments and job-seekers. Inevitably, a range of cumulative impacts occur, including:

- Increased pollution – from ships, harbour facilities, fish factories, boat maintenance, dredging, runoff from streets and buildings, sewerage discharge, maritime accidents and general litter. Ports are notoriously 'dirty' places. A compounding problem is that many are located in close proximity to wetlands or mariculture projects, which increases the probability of environmental and opportunity costs. Informal settlements are also a major source of pollution as there are few if any municipal services such as drainage and sewerage, road infrastructure, water and electricity. The runoff from these areas is usually highly polluted with raw sewage, oil and litter, which discharges into the sea via the outfall sewers.
- Urban migration, which on the one hand can have positive impacts (e.g. support of and access to social infrastructure), but on the other leads to an escalation of crime, spread of STDs and other societal ills.
- Development and increasing economic activities, combined with urbanisation generally generate greater demand for land and resources, leading to a host of cumulative impacts, including land-take and habitat loss, increased traffic (with associated impacts such as pollution, accidents, etc.).
- Noise and visual impacts that can significantly change the nature and 'sense of place' of a town or area. On the other hand, some ports (e.g. Cape Town and Lüderitz) have managed to achieve synergies between ports, lifestyle and tourism investments.
- The cumulative impacts of tourism are thought to be considerably less than other industries/activities, given that this is largely a non-consumptive type of land/resource use. However, if shore-based and ski-boat angling increases in the future, additional pressure will be placed on inshore fish species, many of which are already under pressure from recreational fishing. The cumulative impacts of

overfishing, pollution and habitat destruction will have a devastating (probably irreversible) impact on coastal fish resources.

5.4. Ports, transport and industrialisation

5.4.1. Current extent - ports

In the early days of the colonial history of southern Africa, there was a huge drive to provide access for the shipment of natural resources from the hinterland to the coast for export. This led to the construction of railways stretching across the continent, which were used for the export of iron ore, copper, gold, diamonds, and other minerals. This also gave rise to the development of ports in safe harbours along the notoriously dangerous coast of southern Africa. The port towns are, therefore, some of the oldest towns in the region, originally built to cater for the export of natural resources and the import of basic commodities for the early colonial settlers. But there are also some very new purpose-built ports in the "Benguela region". The main ports are summarised below (in geographic order from north to south), with specific details supplied in Table 54.1.

Soyo and Cabinda

Since oil and gas were discovered off the coast of Angola, several ports were developed specifically for the oil industry e.g. Soyo and Cabinda in Angola (Figure 5.11). Cabinda is relatively small and caters primarily for the oil industry, but a new dock for containers has recently been constructed (inaugurated in August 2012) and a new deepwater port is planned for nearby Caio (www.allafrica.com, 2012). Soyo is also small, but the Government of Angola plans to build an oil refinery at Soyo and therefore the port is expected to increase in size in future (www.wikipedia.org; www.afritramp.eu).

Table 5.4.1: Port information

Port	Country	No vessels / yr (2011/12)	Draught (m below CD)	Dredging required	No of berths	Cargo types	Rail link
Cabinda	Angola		5m	?	2 oil barges 1 quay	Oil Containers	No
Soyo	Angola		7.3m	Yes	4	Oil General cargo RoRo	No
Luanda	Angola		3.5-12.5m	Yes	21	General cargo Oil Containers	Yes
Lobito	Angola		4-12m	?	4	General cargo Vehicles Oil Fish Break bulk Containers	Yes
Saco/Giraul	Angola		18.5m	?	2	Iron ore Tankers	Yes
Namibe	Angola		9.05-10.05m	?	3	Containers General cargo Fishing	Yes

Walvis Bay	Namibia	3000	12.8m	Yes	8	Containers Bulk e.g. coal, sulphur Passengers General cargo RoRo	Yes
Lüderitz	Namibia	1253	6.1-8.15m	Yes		Mineral products (Zn) Fuel Fish Grapes Sulphur General cargo	(Yes)
Saldanha	RSA	528	20.5m	Yes	4	Iron ore Steel Heavy minerals Pig iron Liquid bulk Coal and anthracite Fish	Yes
Cape Town	RSA	2775	9-15.4m	Yes	34	Containers Fresh produce Grain Fish Bulk e.g. coal Timber Steel Paper Liquid bulk Passengers	Yes
Mossel Bay	RSA	1567 (2008/9)	6.5m	No	5	Oil Break bulk Fish	Yes
Port Elizabeth	RSA	1176	11-12.1m	?	9	Mn ore Vehicles Fruit Fish Passengers	Yes
Coega	RSA	383	14m	?	5	Containers Liquid bulk Dry bulk	Yes

CD means Chart Datum; RoRo means roll-on; roll-off.

Luanda

The Portuguese founded Luanda in 1576 and with time, the city became the capital of Angola and its largest port. Luanda has an excellent natural harbour, with the depth in Luanda Bay exceeding 20 m. Currently though, the draught is only 10.5 m, allowing a maximum vessel size of about 30,000 deadweight tonnes. Thus there is the potential for vessels larger than 150,000 deadweight tonnes to enter the bay, but this would be dependent on dredging activities being sustained (Nathan 2010). The chief exports are coffee, cotton, sugar, diamonds, iron and salt (www.wikipedia.org). Even though the port has recently undergone an expansion, it experiences serious congestion, making its facilities so costly and frustrating to use that traffic is increasingly diverting to Walvis Bay in Namibia (Pushak and Foster 2011). Truck cycle time, at 14 hours, is over twice as long as other southern African ports, crane productivity is less than half that of other southern African ports and port-handling charges are among the highest in Africa (almost five times what is charged at the Port of Mombasa and 25 percent higher than Durban (*ibid*)).

Lobito

The terminus of the Benguela railway is at Lobito. This railway, which was completed in 1929, stretched across the country and linked up with other railway systems in the interior. It thus provided a route for the export of agricultural produce, timber, copper, cobalt and other minerals from DRC and Zambia. Extensive damage to the railway during the civil war period (1975-2002) meant that the Port of Lobito also fell into disuse. The railway is currently being repaired with Chinese funding and the section between Lobito and Huambo offers regular passenger services. The entire line up to the DRC border at Luau is expected to be completed by the end of 2012. This upgrade has been done in tandem with a major renovation of the port facilities and the development of the town as an industrial centre, with ship building facilities, sugar refineries, fish canning factories and the manufacture of building materials (www.britannica.com). In 2009, 2.4 mt of cargo moved through the port, including vehicles and almost 25,000 containers. It is likely that the Port of Lobito will continue to grow to cater for the increased flow of freight from the interior of the continent.

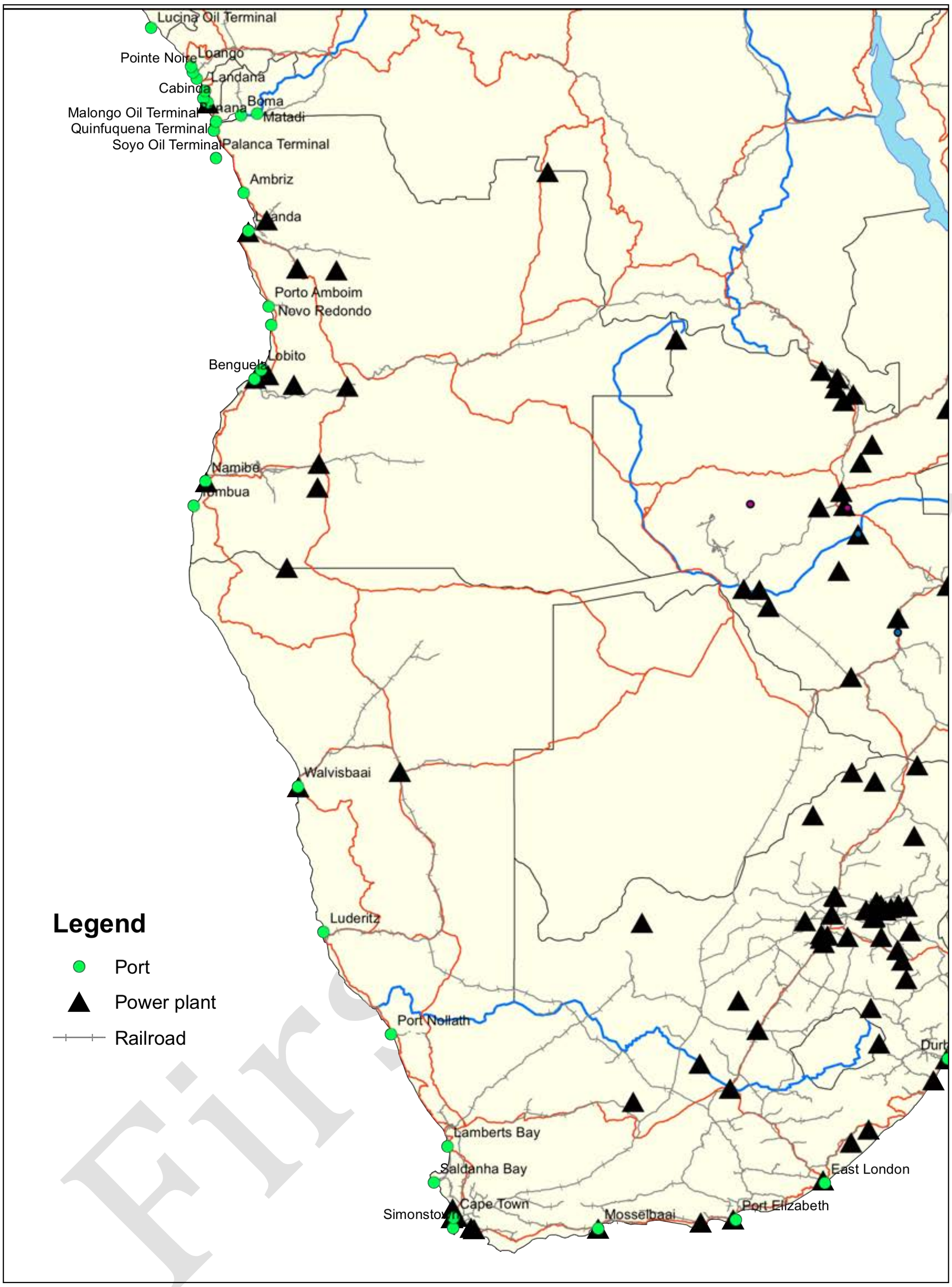

Figure 5.11: Ports and railway infrastructure in south-western Africa

Saco/Giraul

There is a dedicated iron ore port at Saco/Giraul near Namibe. The port is equipped with a conveyor system and can handle bulk carrier vessels up to 200,000 deadweight tonnes with a 16.4 m draught. In addition to the iron ore quay there is a tanker quay with an 18.5 m draught.

Namibe

The Port of Namibe is very small with only three berths and a draught of 10.5 m for cargo vessels. It caters mostly for coastal lighters and fishing vessels.

Walvis Bay

The next main port along the Benguela coastline lies some 1,000 km south of Namibe, at Walvis Bay in Namibia. Walvis Bay is Namibia's largest commercial port, receiving approximately 3,000 vessel calls each year and handling about 5 million tonnes of cargo. It is a sheltered deepwater harbour benefiting from a temperate climate. Fortunately, no delays are caused by bad weather and the harbour is regarded as one of the most efficient on the continent[25]. This fact, coupled with the fact that the location of the port reduces the transit time for ships to Europe by three days compared to Cape Town and has a five-day advantage over Durban, makes Walvis Bay a desirable export port. The container terminal can host about 250,000 containers per annum, but NamPort is currently investing R2.7 billion on upgrading these facilities and deepening the draught from 12.8 m to 16 m to cater for the larger container vessels (Engineering News, 2010).

To support this expansion, the Walvis Bay Corridor Group is actively developing trade routes into the southern African region. The port is linked to the continental hinterland by a number of road and rail corridors, such as the Trans-Kalahari Highway linking the port to the industrial heartland of South Africa, via Windhoek and Botswana; the Trans-Caprivi Highway, which links it to Zambia and DRC; and the proposed Trans-Cunene Corridor. In May 1997, the governments of Namibia and Angola formally agreed to create the Trans-Cunene Corridor as a means of opening up the economies of northern Namibia and southern Angola, comprising road and rail links between Walvis Bay and Lubango/Namibe – a road distance of 1,551 km. Ultimately, this corridor will link with the east-west Benguela railway line.

In an effort to further attract development to Walvis Bay, the municipality zoned an area behind the barrier dunes to be an Industrial Development Zone. Even though the site is adjacent to the airport, there has been little uptake of the development opportunities offered.

Lüderitz

Lüderitz is one of the older ports on the south-west African coast, having been established in the 1800s by Adolf Lüderitz, a German merchant. However, as the land-based diamond mining industry around the town closed down and the railway line fell into disuse, the port slowly declined and was almost abandoned in the early 1990s. However, it has seen a reversal in fortunes, particularly with the development of the Skorpion Zinc mine in the early 2000s, as it had to be upgraded to handle imports of sulphur, fuel and other mining inputs, and the export of zinc. It is now marketed as the 'Gateway to Southern Namibia' and the Namibian government has reinvested heavily in expanding the port and its infrastructure, including the reconstruction of the railway line. This has resulted in a five-fold increase in the volume of cargo since 1994. The port also services coastal lighters, the fishing industry and near-shore diamond boats (www.ports.co.za/luderitz.php).

Saldanha

The Port of Saldanha is South Africa's largest natural anchorage and deepest water port. The port was purpose-built in the early 1970s at the terminus of an 861 km

[25] www.namport.com.na, accessed 26 September 2012.

railway line from the Sishen iron ore mines in the Northern Cape. The Sishen mine is one of the world's largest open pit mines and produced 38.9 mt of ore in 2011, 85% of which was exported via the Port of Saldanha (www.angloamericankumba.com). The ore loading jetty is capable of an average loading capacity of 6,500 tonnes of ore per hour, with a peak rate of 10,000 tph.

The port area (land and sea) covers 18,300ha and in addition to the ore jetty, includes oil tanker berths, the South African Naval Station, SAS Saldanha, a NSRI station and a fishing harbour. The port accepts vessels up to 20.5 m draught and the port entrance channel is regularly dredged to a depth of -23 m CD. In addition to iron ore, the port now handles a range of exports such as heavy mineral products and pig iron from Namakwa Sands, steel coils from Saldanha Steel and steel products from Duferco. Imports mostly comprise oil, as well as raw material inputs for Saldanha Steel and Duferco, such as coking coal, anthracite and steel pellets. During 2011/12, the Port handled a total of 528 ships and moved 58.26 mt of cargo (www.ports.co.za/saldanha-bay.php). It should be noted that Transnet has been steadily increasing the capacity of the railway line, up to a maximum of 60 mtpa. This is likely to increase the tonnage moved through the port as well as the number of vessels.

The town of Saldanha Bay has grown up around this port and now it has become a major industrial centre, with a proclaimed Industrial Development Zone. There are already several industries present in the area, such as the above-mentioned Saldanha Steel, owned by ArcelorMittal, which produces 1.2 mt of export steel per year, Duferco Steel, and a 3.6 Ml/d Reverse Osmosis desalination plant (used for dust suppression at the iron ore jetty).

Cape Town

Cape Town is situated on one of the world's busiest trade routes and will always retain strategic and economic importance for that reason alone[26]. It is also a busy container port, second in South Africa only to Durban, and handles the largest amount of fresh fruit in the country. Fishing has a significant place in the economic activity of the port, affecting the ship repair industry in particular, with large Asian fishing fleets using Cape Town as a transhipment, logistics and repair base for much of the year. During the 2011/12 financial year Cape Town handled 2,775 vessels for a gross tonnage of 51.00 mt. Total cargo handled at the port (excluding containers) was 3.85 mt, of which 3.53 mt was bulk cargo, and 0.33 mt breakbulk. These figures do not include container tonnage, which is estimated as being 10.67 mt for 2008/09 giving the port a total tonnage handled of 14.52 mt (www.ports.co.za/cape-town.php).

The emerging oil industry in West Africa uses the Port of Cape Town extensively for rig repair and maintenance, while the port also provides the main logistical services for the deep sea diamond mining vessels. The Port is also a popular call for cruise ships, but lacks a dedicated passenger receiving facility at present.

Cape Town has a number of bunkering points within the port supplying marine fuel oil, gas oil and blends and the port is serviced by a bunker barge. A full range of ship chandling and stevedoring is available. The port, which is situated close to the central business district, houses a yacht club and marina as well as a NSRI base.

[26] http://ports.co.za/cape-town.php, accessed 26 September 2012.

Plate 5.6: Container vessel in Cape Town harbour

Mossel Bay
Mossel Bay is the smallest of the commercial harbours along the South African coast, catering primarily for the fishing and oil industry. It has two offshore mooring points for marine tankers. The number and size of vessels visiting the port is constrained by the shallow draught of 6.5 m and the small berths.

Port Elizabeth
Historically, PE was an important port on the South African coast and handled agricultural produce for export. Over time, the port was expanded to cater for the export of manganese ore railed from the Northern Cape, motor vehicles from the nearby automotive plants and it became an important container port and passenger terminal.

When the nearby Coega port was developed, the original plan was for bulk cargoes, e.g. the manganese ore, to be moved from PE to Coega, with PE retaining the container traffic. However, Coega did not develop as planned, and now the bulk of the container traffic is handled through the latter and manganese ores are still handled in PE. It is expected that the volume of container shipping handled by Port Elizabeth harbour may decline in future and it is likely that the Port will focus on specific export cargoes, such as automobiles, agricultural produce (especially fruit) and manganese ore. The fishing industry also makes extensive use of the port.

There are no major ship repair facilities but a slipway is available for fishing vessel repair. Passenger ships usually make use of one of the fruit terminal berths when calling at Port Elizabeth. The port's container terminal has three berths totalling 925 m in length and a storage area of 22 ha with 5,400 ground slots for stacking purposes. The container terminal is equipped with latest generation gantry container cranes and straddle carriers. The breakbulk terminal has 6 berths (1,170 m), two bulk berths totalling 360m and a tanker berth of 242 m. The port has adequate rail and road links with other parts of the country.

The entrance channel to Port Elizabeth is maintained at a depth of -14.5 m CD and has a generous width of 310 m. Limitations on vessels using the port are 11 m draught for passenger and dry cargo vessels, 11.2 m for container ships, 12.1 m for ore carriers and 9.6 m for tankers, all according to berthing.

Port Elizabeth handled a total of 1,176 ships during the 2011/12 financial year ended 31 March 2012, with a total tonnage of 27.01 mt.

Coega

The port of Coega (alternatively spelt Ngqura) lies 20 km to the east of PE and is South Africa's newest port. It is linked to a 12,000 ha Industrial Development Zone (IDZ), which was constructed specifically to boost industrial development in the impoverished Eastern Cape. The port began operations in 2009 and it currently has 5 berths, but there are plans to expand it to accommodate 32 berths, with the vision that it will act as a transhipment hub for the Sub-Saharan and West Indian Ocean container traffic (www.ports.co.za). It has been designed to handle new generation ships such as the Post-Panamax dry and liquid bulk tankers and cellular container ships. It can accommodate ships with a draught of 14 m and up to 300 m in length. The port handles containers, dry bulk and liquid bulk vessels and in 2011/12, it handled a volume of almost 7 mt from 383 ships.

Other small ports and harbours

In addition to the main ports, there are at least 28 small harbours around the BCLME coastline catering primarily for the fishing industry, the boat-based diamond mining industry (on the west coast of South Africa) and recreation (mostly in South Africa) (see Table 5.4.2).

Table 5.4.2: Small ports and harbours

Name	Country	Purpose
Porto Amboim	Angola	Coastal lighters Fishing
Sumbe	Angola	Fishing
Quicombo	Angola	Fishing
Tombua	Angola	Coastal lighters Fishing
Baia dos Tigros	Angola	Fishing
Port Nolloth	South Africa	Fishing Diamond mining
Hondeklip Bay	South Africa	Fishing Diamond mining
Papendorp	South Africa	Fishing
Lambert's Bay	South Africa	Fishing Diamond mining
Elands Bay	South Africa	Fishing
Port Owen / Velddrif	South Africa	Fishing Recreation
St Helena Bay	South Africa	Fishing
Paternoster	South Africa	Fishing
Langebaan	South Africa	Recreation Angling
Yzerfontein	South Africa	Recreation Fishing and angling
Hout Bay	South Africa	Fishing Angling Recreation Tourist operations
Simon's Town	South Africa	Naval base Recreation Tourist operations Fishing Angling
Kalk Bay	South Africa	Fishing
Gordon's Bay	South Africa	Fishing Recreation

Kleinmond	South Africa	Fishing Angling
Hawston	South Africa	Fishing
Hermanus	South Africa	Fishing Angling Recreation Tourist operations
Gansbaai	South Africa	Fishing
Struisbaai	South Africa	Fishing
Arniston	South Africa	Fishing
Knysna	South Africa	Fishing Angling Recreation Tourist operations
Keurbooms	South Africa	Recreation Tourist operations
St Francis Bay	South Africa	Recreation

5.4.2 Current extent - shipping

Shipping is confined to defined shipping lanes to avoid accidents, particularly in busy areas and on entering and leaving ports. The shipping lanes were defined on the basis of wind direction and currents in order to optimise both as far as possible (www.wikipedia.org). One of the main routes from Europe to Africa and the Far East passes around the Cape of Good Hope and along the south coast of South Africa (Figure 5.12). It is also clear from this figure that there is also a considerable amount of ship movement from the Cape along the west coast of southern Africa to states on the Gulf of Guinea. Much of this traffic is related to the oil and gas industry and their use of Cape Town as a repair and maintenance centre. It is also reported that two small shipping lines have begun regular services between Cape Town, Angola and the West African states (West Coast Business News and Directory, Sept 2011).

Quantification of the volume of traffic passing through the BCLME each year is beyond the scope of this scoping report, but on a random day (15th November 2012), there were 196 vessels (of all types) active, moored or at anchor in BCLME waters (www.marinetraffic.com).

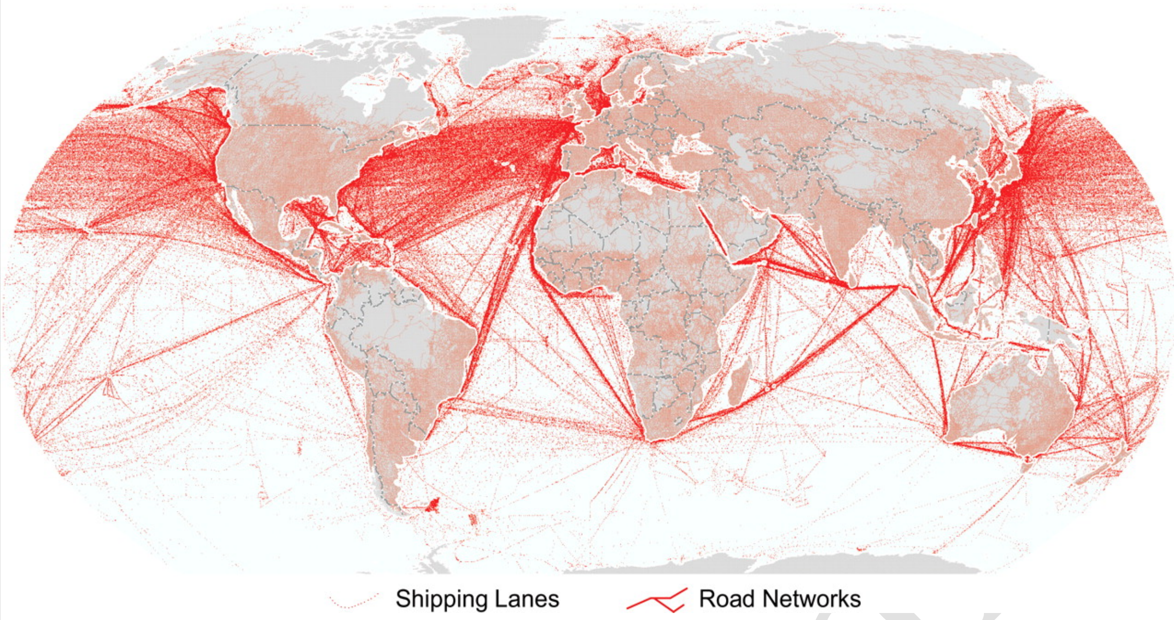

Figure 5.12: Global shipping lanes (Google images)

5.4.3 Current extent – industrialisation

There is little industrial development along the BCLME coast outside of the ports and mines described above. The main installation to note is the Koeberg Nuclear Power plant north of Cape Town, which uses seawater for cooling purposes and discharges heated effluent to the sea. The only other coastal installations are desalination plants located at Mossel Bay and north of Swakopmund in Namibia (in addition to the current and proposed plants at Saldanha Bay described above), and fish factories at most of the ports and harbours listed in Tables 5.4.1 and 5.4.2.

5.4.4 Future scenarios

It is expected that the main ports in all three BCLME countries will expand substantially over the next 10-15 years.

Luanda, which is a major transit port not only for Angolan goods but also for the Democratic Republic of Congo, Zambia, and Zimbabwe, is likely to grow at a faster rate than any African port. It is already benefitting from rehabilitation, expansion, and upgrading and has recently acquired three new tugs to speed up the mooring and departure of vessels, and thus increase port capacity. Luanda has also begun to move ships offshore and offload cargo onto barges using ship's gear (Nathan 2010). In an effort to ease the congestion at the Port of Luanda, a dry port has been developed at Viana, about 30 km inland and a new container port is also being planned for a 2,400 hectare site at Barra do Dande, north of Luanda, which is being cleared of land mines (Nathan 2010). In addition, a new container port and tank farm is being built at Porto Amboim, approximately halfway between Luanda and Lobito.

NamPort is looking to further expand the Port of Lüderitz to cater for the differing needs of the fledgling oil and gas industry in Namibian waters (www.ports.co.za), and as noted earlier, Walvis Bay harbour is scheduled for major expansions whilst feasibility studies have been initiated for proposed harbours north of Swakopmund and at Cape Fria.

In South Africa, creation of an IDZ next to the Port of Saldanha is likely to attract businesses to the area. Some of the proposed developments identified in South Africa's West Coast Business News and Directory include:

- A 25.5 Ml/d desalination plant for the West Coast District Municipality;
- A titanium and zirconium refinery, using feedstock from Namakwa Sands and salt by-products from the desalination plant;
- A R2.2 billion integrated cement plant using limestone from nearby deposits (Afrisam);
- Sunrise Energy (Pty) Ltd is proposing to develop an LPG storage facility, which would require a Conventional Buoy Mooring System for offloading and land-based storage tanks, equipment, road and rail gantries and possible bulk pipeline. Construction is expected to commence in 2013, with the plant becoming operational in late 2014 (West Coast Business News and Directory, January 2011);
- Avedia Energy is about to begin the construction of an 8,000 mt LPG facility in Saldanha, Western Cape, South Africa. It already has an LPG handling facility at the port;
- A 750 MW Closed Cycle Gas Turbine (CCGT) plant is planned for Saldanha, receiving gas from the Ibubhesi Gas Field. This joint project between African International Energy and PetroSA is likely to start production by the end of 2016;
- Universal Africa Lines wants to invest in a specialised oil and gas servicing hub at Saldanha to meet the increasing demands from the West African oil and gas producers, Angola and potential local producers;
- Mining Oil and Gas Services are currenly undertaking a feasibility study for a crude oil tank farm on a 52 ha site in the Saldanha area with storage for 12 million barrels of oil.

In addition, in April 2012, Transnet Freight Rail confirmed that it had earmarked R25 billion to increase the capacity of the Orex rail line to export 82 mtpa of iron ore from mines in the Sishen area over the next 7 years. The current line capacity is for 33 loaded trains per week, but this will be increased to 40 trains per week from September 2012. In order to accommodate the increased volumes, new infrastructure will have to be built on 141 ha of land next to the current iron ore jetty, with an additional 50 ha being reclaimed from the sea. It will also require a deeper channel to be dredged, two new shipping berths and an increased stockpile area. This will also mean an increase in the number and size of the bulk carriers calling at the port, predicted to be over 200 iron ore ships per year (up from the approximate 100 per year in 2007) (West Coast Business News and Directory, May 2012) (www.saaea.blogspot.com).

Port Elizabeth faces losing some of its container business, and in the future all of its dry and liquid bulk traffic to the new Port of Coega – some 20km away, which has been open since October 2009.

5.4.2. Environmental Impacts

Table 5.4.3: Direct and indirect impacts of ports, shipping and industrial development

Main Construction Activities

- Shoreline vegetation clearance
- Water diversion works
- Dredging and disposal of dredge spoil
- Blasting (in some cases)
- Bulk earthworks
- Piling and concrete work including batch plant
- Construction of groynes, breakwaters and other protection works
- Landside construction of buildings and related infrastructure
- Access roads and tracks
- Contractor's camp, yard and workshop
- Waste disposal
- Construction traffic
- Labour force

Main impacts of Construction on the natural environment

- Direct loss of coastal/shore/bank vegetation and faunal habitat
- Temporary or permanent interruption of ecological corridors
- Possible release of toxic substances during dredging and dredge spoil disposal activities
- Smothering of benthic fauna due to dredge spoil disposal
- Increased turbidity due to dredging, spoil disposal, re-suspension of fines and other construction activities will affect light penetration and ecosystem functioning
- Accidental hydrocarbon spills will have acute, chronic and lethal effects on marine and shoreline organisms
- Introduction of alien organisms and plants from construction equipment and machinery
- Effects of blasting on marine mammals, seabirds, fish and fisheries

Main Operational Activities

- Arrival and departure of vessels
- Loading and offloading of vessels
- Boat launching
- Handling, storage, conveyance and transfer of cargo including containers, break bulk cargoes, diesel and oil, liquid products and bulk materials
- Marine services including boat cleaning, painting, repairing, welding etc
- Ongoing dredging of channels
- Fish processing facilities
- Solid and liquid waste disposal from

Main impacts of operations on the natural environment

- Introduction of alien species from boats and discharge of ballast water
- Erosion of banks and shorelines by boat wakes leads to loss of breeding sites for birds and other organisms
- Impact of oil spills on seabirds, marine, inter-tidal and shore organisms (acute and chronic effects, mortality)
- Depletion of fish stocks due to over-fishing
- Impacts of litter and waste on fish, marine mammals and shoreline fauna
- Direct and indirect effects on sensitive

wharf operations and vessels • Effluent and runoff disposal from wharf and wharf-side factories, processing plants and stockpiles • Re-fuelling and provisioning of boats • Discharge of ballast water	ecosystems e.g. mangrove swamps, estuaries etc due to perturbations in wave, current and sediment transport regimes resulting in shoreline accretion and/or erosion • Impacts on water quality due to erosive effects of wind and water on loose material stockpiles e.g. coal, iron ore, manganese, titanium etc • Impacts on water quality and marine organisms from runoff and effluent disposal from shore-based activities e.g. fish processing factories • Toxic effects of anti-fouling paints on aquatic/marine organisms resulting in growth and development defects • Impact of ship movements on marine mammals e.g. whales and other cetaceans, as well as large fish (such as sharks) • Bioaccumulation of toxins in edible marine organisms e.g. mussels, crabs, lobsters with indirect effects on human health • Loss of subsistence fisheries and marine harvesting areas

Cumulative impacts and linkages

Shipping, ports and industrialisation combine to produce a hub for a great variety of developments. Their presence and growth in a coastal town/city provides a critical mass of economic activities that attracts multiple investments from associated industries and service providers. Most of the impacts relating to ports and urban areas have been described in section 5.3.3 above. However, there are a range of impacts that are specific to shipping activities, which per individual ship may be relatively small, but which, when assessed on the basis of the entire shipping volume, can add up to significant cumulative impacts, including:

Greenhouse gas emissions
Current estimates show that shipping is responsible for 4-5% of the global total greenhouse gas emissions (GHG). The IMO expects this to rise by up to 72% by 2020 if left unchecked. Thus the IMO set up a Working Group in 2008 to develop technical reduction mechanisms (www.wikipedia.org).

Ballast water
Cruise ships, large tankers and bulk cargo carriers use a huge amount of ballast water – often taken on in coastal waters of one region and discharged in another as the ship takes on cargo and passengers. Ballast water typically contains a variety if biological materials including plants, animals, viruses and bacteria which may become a nuisance or invasive in new environments, causing immense damage to native marine and freshwater ecosystems. Fortunately, the cold waters of the

BCLME are not conducive the growth of many of the alien species causing problems in other parts of the world.

Noise

The noise produced by ships can travel for long distances which can affect marine species that rely on sound for their orientation, communications and feeding (ibid.).

Ship impacts

Marine mammals, such as whales risk being struck by ships causing death or injury. A review of the stranding records for Southern Right Whales by Best et al (quoted in Laist et al., 2001) found that ship collisions accounted for 20% of the recorded deaths. This is likely to be an underestimate, given that the study was restricted to examining stranded whales only. Most studies show that ships longer than 80 m and going at speeds greater than 14 knots cause the greatest number of impacts (ibid.).

Exhaust emissions

Ships are a significant source of air pollution, contributing 18-30% of all nitrogen oxide and 9% of sulphur dioxide pollution globally (Figure 5.13). Most ships burn high sulphur fuel oil which produces these gases, as well as carbon monoxide and carbon dioxide, and particulates. The degree of air pollution caused by ships depends on the atmospheric conditions in port (especially wind and atmospheric stability) as well as the number of ships. Many of the ports in the BCLME region experience strong wind conditions for a large part of the time, but under certain situations, air pollution levels in the City of Cape Town can be problematic. However, the relative contributions from ships and other land-based sources needs further research.

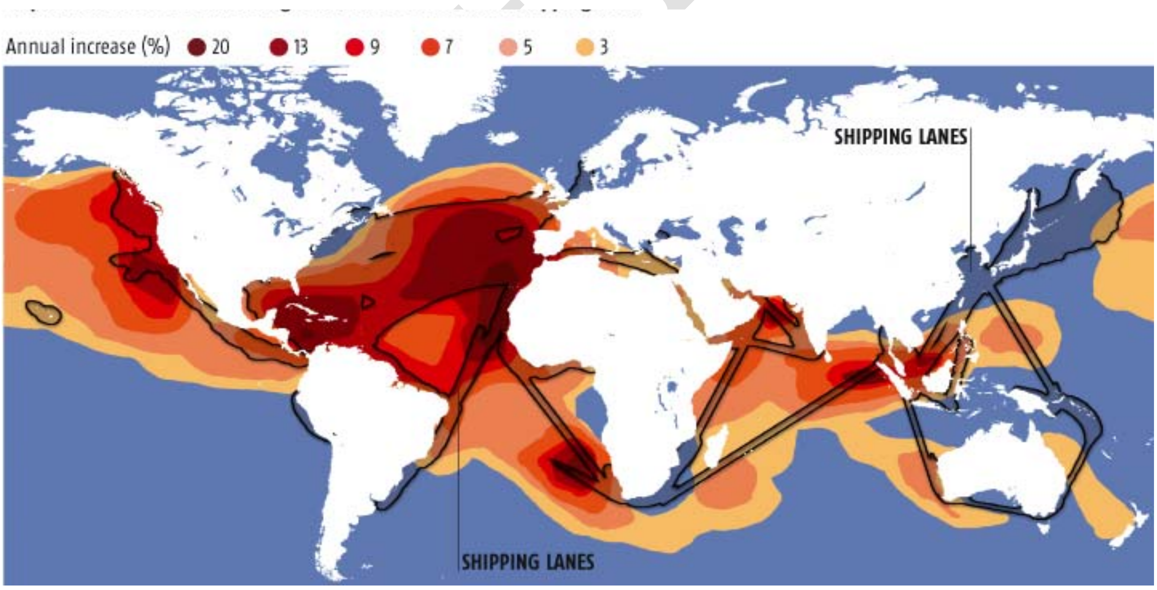

Figure 5.13: Suphur dioxide emissions from ships (www.wikipedia.org)

Oil spills

Catastrophic spills of crude oil and heavy fuel oil are very difficult to clean up and may last for years in the sediment and marine environment (www.wikipedia.org). Ships are regulated via the provisions of the Marine Pollution Treaty and UNCLOS, but most regulations are viewed as inadequate to prevent accidents caused by unseaworthy ships and human error. There have only been 6 major oil spills in the BCLME area since 1983, as documented in Table 5.4.4. Most have had significant impacts on seabirds, especially penguins, cormorants and gannets, and untold impacts on marine life in the affected areas.

Table 5.4.4: Oil spills in the BCLME region since 1980

Ship	Location	Date	Quantity of oil spilled	Comment
Castillo de Bellver	Saldanha Bay	06/08/83	79 million gallons	One of the 10 worst spills in the world
ABT Summer Oil Spill	700 nautical miles off Angola	28/05/91	51-81 million gallons	Oil tanker exploded. Also in top 10 worst spills
Treasure	Table Bay (Cape Town)	23/06/00	1300 tonnes of fuel oil	Iron ore ship sank
Seli 1	Bloubergstrand, Cape Town	07/09/09	600 tonnes of heavy fuel oil	Coal carrier ran aground
Unknown source	Off Lüderitz	April 2009	Unknown	Oil spill
Unknown source	Off Cabinda	August 2010	Unknown	Oil spill

Plate 5.7: The bulk coal carrier, Seli 1 aground on Bloubergstrand in Table Bay

Sewage and wastewater

Much of the literature on the subject of sewage and waste from ships relates to cruise ships, which by definition have a high number of passengers on board and therefore produce a greater amount of waste per vessel than cargo ships. However, there are far more cargo ships in operation around the BCLME coast than cruise ships and therefore the cumulative effects of waste discharge from cargo ships needs to be determined. Nevertheless, estimates of waste quantities from a 'typical' cruise ship with 3,000 passengers and crew provide an indication of the volumes involved (Table 5.4.5).

Table 5.4.5: Estimated volumes of waste from a typical cruise ship*

Waste category	Waste components	Estimated volumes	Environmental impacts
Blackwater	Solid and liquid sewage, hospital washdown water	55,000 – 110,000 litres/day	Bacteria, pathogens, viruses, intestinal parasites can cause bacterial and viral contamination of fisheries and shellfish giving rise to public health risks. Nutrient loading can cause algal blooms and oxygen reduction which kills fish and aquatic life
Greywater	Wastewater from sinks, showers, galleys, laundry and cleaning	330,000 – 960,000 litres/day	Faecal coliforms, detergents, oil and grease, phosphates, metals and organic compounds, food waste and nutrients can be harmful to marine life.

	activities		
Solid waste	Glass, paper, cardboard, aluminium and steel cans. plastics, etc	> 1 tonne/day	Marine mammals, fish, sea turtles and birds can be injured or killed from entanglement with plastics and other solid waste. Flotsam in the water washes up on beaches affecting tourism and can clog up seawater intake structures. Although as much as 75% of this waste may be incinerated on board the ship, the ash is typically discharged at sea.
Bilge water	Oil, gasoline, grease from ship's engine room	8 tonnes/day	Bilge water is supposed to pass through an oil separator prior to being discharged, but this does not always happen and the hydrocarbons can kill fish or have sub-lethal chronic effects.

* Based on a cruise ship carrying 3,000 passengers and crew Data source: xxxx

Discharge from desalination

The need for desalination is not linked solely to increasing industrialisation, but rather the combined pressure on freshwater resources from industry, mining, coastal development and other activities.

The impacts of desalination effluent depend on the method of desalinization used. Danoun (2007) states that although often ignored, desalination plants have the potential to cause environmental impacts through:-

- The use of several potentially toxic chemical substances needed for the pre-treatment stage of desalination. Chemicals include disinfectants, anti-bacterial agents, anti-flocculants, pH adjustors, membrane cleansers and anti-scaling chemicals. [27]
- Desal effluent will have a direct impact on temperature, pH and salinity of the water column. Different species will have different tolerance levels to these altered conditions – in particular changes in salinity and temperature. The population dynamics of some species may benefit from these changes, while others will not. This will cause altered species assemblages and ecological functioning within the area of influence of the emissions plume. Total alkalinity tolerance of marine life has not been well documented and the overall impact of this change to the water column is largely unknown.

Alien invasive organisms

In addition to the abovementioned cumulative impacts (and as noted earlier), ports, shipping and mariculture may combine to contribute to the introduction and/or spread of alien invasive organisms.

Sink *et al* (2011) emphasise that marine alien and invasive species are an emerging problem in South Africa with increases in the number of known introduced marine species – including microbes, parasites and pathogens - in recent years. Some harmful algal blooms (HABs) are caused by alien species and these can have severe consequences for human health, fisheries resources and the mariculture industry.

The main pathways of introduction of alien invasive species include :-

[27] These may include:- Sodium hypochlorite (NaOCl); Ferric chloride ($FeCl_3$); Aluminium Chloride ($AlCl_3$) ; Sulfuric acid (H_2SO_4) ,hydrochloric acid (HCl) ; sodium hexameta phosphate [SHMP$(NaPO_3)_6$] ; Sodium bisulphate; Crystalline acid EDTA ethylenediaminetetraacetic acid ($C_{10}H_{16}N_2O_8$); Citric acid ($C_6H_8O_7$), EDTA and Sodium polyphosphate.

- Shipping. Human-induced movement of species to new marine environments is most commonly caused by the exchange of ballast water and the transport of fouling biota (e.g. polyps) on ship hulls. Improved ballast water management can reduce the risks associated with HABs *(ibid)*
    - Some jellyfish, especially ctenophores, are resilient to ballast water exchange, and generally increase in abundance once translocated to new areas where the dominant plankton-consuming fish (e.g. anchovies and sardines) in the system have been removed (Richardson *et al* 2009). The Namibian portion of BCLME, which has suffered the depletion of its high-value pilchard and sardine stocks, is now dominated by jellyfish and low-energy species like the bearded goby (Utne-Palm *et al* 2010).
    - Scyphozoan jellyfish blooms have also begun appearing in areas throughout the world, which were previously, free of invading jellyfish species (Richardson *et al* 2009).

- Mariculture. Not only the farmed organisms are potentially harmful but parasites and diseases can be introduced with seeds and spat.
    - cultivated alien species have not yet become established outside the immediate vicinity of the sea farms in Namibia. However, the introduction of new species and the effect of global environmental change (including Climate Change) could increase this risk.
    - In 2004 Bethune *et al.* reported that no invasive alien marine plants had been recorded in Namibia, (what is the situation now ? In Angola ?
    - In South Africa the Mediterranean mussel *Mytilus galloprovincialis* (introduced for mariculture) now occupies the whole of the west coast and the southern half of Namibia (Branch & Steffani, 2004), threatening biodiversity by competitively displacing several other species. It has, however, provided an additional source of food for higher predators, including the rare and endangered African black oystercatcher (*Haematopus moquini*) (Kohler et al 2011).

- Altered environmental conditions. If climate change results in an increased frequency and severity of Benguela Niño events and increased environmental variability then this could alter the potential for the establishment of alien invasive species dramatically.

5.5. Extraction of living marine resources

5.5.1. Current extent

The total nominal landings from the BCLME, peaked at slightly more than 3 mt in 1968 but subsequently declined and have been below 2 mtpa since then. After average annual landings of approximately 1.6 mt between 2000 and 2005 they declined to about 1.2 mt in 2009. The major components of the landings from the BCLME region include ISSCAAP Group 35 (herring, sardine and anchovies), Group 37 (miscellaneous pelagic fishes [including horse mackerel]) and Group 32 (cods, hakes and haddocks) (Figure 5.1.4). A more detailed breakdown of the most important species being caught by the fisheries and the countries in which they occur is provided in Table 5.4.6, including those stocks which are shared with neighbouring states to the north.

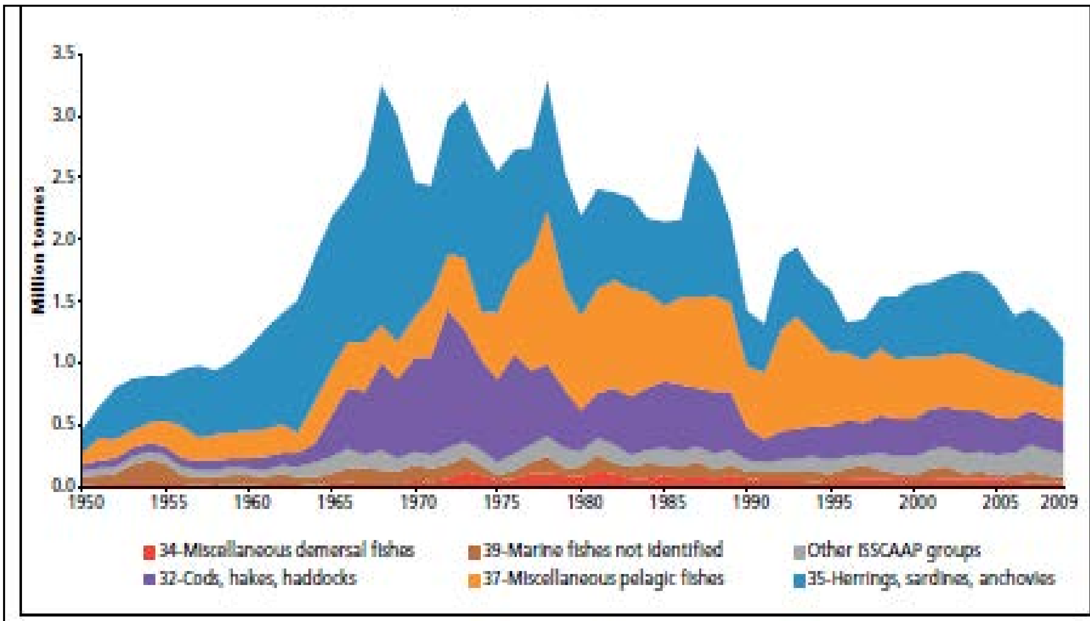

Figure 5.1.4. Annual nominal catches of fish from the BCLME region by ISSCAAP (International Standard Statistical Classification of Aquatic Animals and Plants) group (FAO 2011).

Table 5.4.6. The more important marine species occurring in the BCLME and the countries in which they are fished, including fishery resources and species of conservation concern (Cochrane et al. 2009).

Species	**Countries in which each species is found**		
	Angola-Congo-Gabon	**Angola-Namibia**	**Namibia-RSA**
Deep-water Cape hake			√
Shallow-water Cape hake			√
Longfin tuna			√
Snoek			√
Seabirds (albatrosses and petrels)		√	√
Cape Fur Seals		√	√
Kabeljou & other linefish	√	√	√
Sardine		√	√
Sardinellas	√	√	
Cunene horse mackerel	√		
Cape horse mackerel		√	√
Large-eye dentex	√	√	

Deepwater crab		√	√
Various sharks	√	√	√
Various other demersal species	√	√	√

The fisheries in each country have developed independently and are managed separately, even in those instances when the stocks are shared between two countries. The capture fisheries are therefore described below by country.

Angola

The exclusive economic zone of Angola can be divided into two fishing zones. The northern area, extending from Luanda to Cabinda is dominated by warmer and less productive waters. The two sardinella species, round *Sardinella aurita* and Madeiran or flat *S. maderensis*, together with Cunene horse mackerel *Trachurus trecae* are the primary targeted resources, while demersal species make up a smaller proportion of the total catch in this northern region. The southern region extends from Lobito to the mouth of the Cunene River and is the more productive of the two, supporting high catches of demersal species as well as horse mackerel, including the Cape horse mackerel *T. capensis*, sardine *Sardinops sagax* and tunas. The demersal species of most importance include the Benguela hake *Merluccius polli*, and large-eyed dentex *Dentex macrophthalmus*.

Crustacean fisheries are also a major commercial fisheries sector in Angola. These include the deep water Geryon crab (*Chaceon maritae*) whose range is global, but which is fished commercially in Angola and Namibia, the deep-water Rose shrimp (*Parapenaeus longirostris*) and the Striped red shrimp, (*Aristeus varidens*). Angola also has a significant offshore fishery for tunas and currently licenses both a domestic fleet and vessels from *Distant Water Fishing Nations.* The primary tuna target species are the albacore (yellowfin) and bigeye tunas. There is also reported to be a significant shark-directed fishery both inshore and offshore of Angolan waters.

The fisheries sector in Angola consists of an industrial and an artisanal sector. The industrial sector consists of two demersal trawl fisheries, one targeting finfish and the other deep-water shrimp, a mid-water trawl fishery targeting meso-pelagic and pelagic species (currently suspended), a demersal line fishery, a mid-water long-line fishery mainly targeting large pelagic species, and a purse seine fishery targeting small pelagic species.

The artisanal fisheries sector includes an estimated 6,775 boats, of which the majority are canoes, although their frequency decreases towards the south of the country probably because of the rougher seas in the southern parts (Sowman et al. 2011). The fishing gears used include handlines, beach seines (banda banda), surface and bottom gillnets, lift nets and poling. The artisanal fisheries exploit a wide variety of species, including the small pelagics and demersals targeted by the commercial fisheries.

Namibia

Namibia's marine capture fisheries sector is entirely industrial, apart from an informal rod and line fishery for silver kob *Argyrosomus inodorus* and other species. The commercially most important fishery is the demersal trawl fishery which targets mainly shallow-water and deep-water Cape hakes *Merluccius sp.*, monkfish *Lophius vomerinus*, snoek *Thyrsites atun*, sole *Austroglossus microlepis* and kingklip *Genypterus capensis*. The mid-water trawl fishery is the largest sector by volume and targets Cape horse mackerel[28]. It is also commercially important and an important source of low cost fish for human consumption to the local markets and to neighbouring countries. The purse seine fishery is a relatively small fishery that relies on sardine, a resource which has never recovered in the northern Benguela after being badly overfished in the 1960s and 1970s. There are also fisheries for tuna, West Coast rock lobster, and the deep-sea red crab shared with Angola.

Namibia places an emphasis on employment generation in its fisheries sector and requires a fixed proportion of the hake total allowable catch to be landed and processed ashore. Overall, about 85% of the fish landed is processed in Namibia and then exported (FAO National Fishery Sector Overview: Namibia).

South Africa

South Africa has a diverse marine fisheries sector of which by far the most productive components occur within the BCLME region. The sector is dominated by the demersal hake trawl fishery, targeting mainly shallow-water and deep-water hake and the pelagic purse seine fishery which targets anchovy *Engraulis encrasicolus* and sardine as well as lesser catches of juvenile Cape horse mackerel and redeye round herring *Etrumeus whiteheadi*. There is also a small inshore trawl-directed fishery for sole *Austroglossus pectoralis* and shallow-water hake found on the south coast, and small fisheries for hake using demersal longlines and handline.

The South African line fishery catches approximately 200 species, many of which are endemic. This fishery has however been declared in a state of crisis and effort has been significantly reduced in both the recreational and commercial "linefish" sectors. Currently only a small number of linefish species are permitted to be caught commercially (snoek, kabeljou, yellowtail, geelbek and a few others) and it is these species that make up the bulk of the current catch in the sector. The fishery consists of a traditional fishery operating from boats using handlines or rod and line, a large recreational component and a much smaller subsistence component. Snoek, yellowtail and kob are some of the most important target species for this fishery.

Important fisheries for invertebrates include that for West Coast rock lobster using mainly traps and hoop nets, the trap fishery for South Coast spiny lobster *Palinurus gilchristi* on the Agulhas Bank, a jigging fishery for chokka squid *Loligo vulgaris reynaudii* and the fishery for abalone which is concentrated on the south west coast of the country. The landing sites for these fisheries are distributed along the west, south west and south coasts and include Port Nolloth, Saldanha, Cape Town, Gansbaai, Mossel Bay and Port Elizabeth, amongst others.

5.5.2. Future scenarios

The commercial fishing sector in the BCLME, especially in Namibia and South Africa, has been reasonably well-managed for several decades and still retains some capacity and competence to be able to maintain this state. However, the three countries are facing a number of potentially serious challenges, including the environmental impacts discussed in the next section, and the future of fisheries and the resources they depend on are in a vulnerable state.

[28] There is also a small purse seine sector that targets both sardine and horse mackerel

A study undertaken under the auspices of the GEF-funded BCLME programme considered the current capacity in the region for implementation of effective governance within the framework of an ecosystem approach (Cochrane et al. 2009). The study concluded that there were a number of areas of concern but that there was sufficient capacity at present to enable adequate management including implementation of an ecosystem approach. Nevertheless, the study identified limitations in general management capacity as being a serious concern, particularly in Namibia and South Africa. Insufficient capacity was being experienced particularly in terms of research and management but also applied to policy, economics, and the social sciences. Recent losses in capacity were making the situation even more serious in Namibia and South Africa and were exacerbated by problems in these two countries to retain qualified and experienced staff. Other problems identified included the need to strengthen the resource management structures to allow for improved interaction with stakeholders and better incorporation of stakeholders in decision-making, including improved interaction with other relevant sectors including, at that time, the offshore hydrocarbon industry and marine mining (primarily diamonds and phosphates). The Angolan participants in the project also identified an urgent need to implement an appropriate system of access rights and to strengthen surveillance and compliance in that country.

The project also considered management and governance at the regional level and recognized that the Benguela Current Commission has an important role to play in facilitating regional cooperation within the fisheries sector and, at least as important, cooperation and cooperative management across the sectors impacting on the ecosystem and its resources. The effectiveness of the Commission is still to be tested but it is an important, if not essential, institution to have in place.

With this background and the likely current and potential future environmental impacts discussed in the next section two potential scenarios can be identified, with a full spectrum of intermediates between the two also possible. On the one hand, if the existing capacity for fisheries management is only maintained or allowed to deteriorate further in the three countries, the growing challenges will overwhelm the ability of the governments to manage the fisheries sector for optimal and sustainable benefits. The combination of: growing pressure on fishery resources from an increasing and widely under-fed and under-employed population; unmanaged or insufficiently managed impacts from other sectors; and likely climate change impacts will inevitably lead to over-exploitation of resources and other long-term damage to the ecosystem. This in turn will decrease fishery yields, negatively reinforcing the downward spiral. The long-term result will be a badly damaged BCLME supporting mainly low value and undersized fish and invertebrate species that will provide minimal income and food for the three countries.

There is also an increasing oil and gas sector that includes exploratory work (seismic surveys), exploratory drilling and expanding infrastructure that includes platforms, wellheads and pipelines. Further recent developments include potential deepwater dredging for phosphate mineral. These activities are not only increasing the potential impacts on the natural resources but also increasing the user conflict and add to the risks.

The alternative, positive scenario requires the three governments to increase their efforts and financial support to their agencies responsible for fisheries management and development to ensure that the capacity of government and of stakeholders to undertake responsible management is maintained and improved, the biological resources are sustainably utilized, and optimal benefits are obtained from the resources by suitable post-harvest practices including, where appropriate value addition. This option will also require effective inter-country and inter-sectoral cooperation and management, challenges which, apart from the very recent creation of the BCC, have to a large extent been overlooked in the past. This scenario will not result in fisheries solving all the social and economic needs of the coastal populations but will ensure that the optimal returns are obtained and contribute to sustainable development of the coastal areas of the BCLME countries.

5.5.3. Environmental Impacts

Table 5.4.7: Direct and indirect impacts of the extraction of living marine resources

Main Construction Activities[29]

- Construction of onshore fish processing facilities, jetties and offloading infrastructure
- Access roads and tracks
- Contractor's camp, yard etc.
- Waste disposal
- Construction traffic
- Labour force

Main impacts of Construction on the natural environment

- Direct loss of coastal/shore/bank vegetation and faunal habitat
- Temporary or permanent interruption of ecological corridors
- Accidental hydrocarbon spills will have acute, chronic and lethal effects on marine and shoreline organisms.

Main Operational Activities

- Fishing
- Arrival and departure of vessels
- Loading and offloading of vessels
- Boat launching
- Handling, storage, conveyance and transfer of cargo including fish and consumables
- Marine services including boat cleaning, painting, repairing, welding etc
- Fish processing
- Solid and liquid waste disposal from processing factories and vessels
- Re-fuelling and provisioning of boats

Main impacts of operations on the natural environment

- Depletion of fish stocks (over-fishing)
- Killing of non-target species (e.g. seabirds, sharks, sea turtles, and threatened finfish species)
- Damage to bottom substrates and ecosystems from bottom trawling and other gear types
- Erosion of banks and shorelines by boat wakes leads to loss of breeding sites for birds and other organisms.
- Impact of fuel spills on seabirds, marine, inter-tidal and shore organisms.
- Impacts of litter and waste on fish, marine mammals and shoreline fauna.
- Impacts on water quality and marine organisms from runoff and effluent disposal from fish processing factories.

Cumulative impacts and linkages

There are also a number of primary threats from outside the fisheries sector that will need to be addressed. These include climate change, which could potentially change the dynamics and distribution of some resources considerably. There have been

[29] It should be noted that landside construction related to fishing and processing is usually done within the footprint of harbours, and therefore there is duplication between this section and that relating to harbours.

some incidences of this in recent decades including an eastward shift of a hundred kilometres or more in the distribution of West Coast rock lobster, sardine and anchovy in South Africa which has had important economic impacts on the fishery, although the distribution now appears to be reverting to the original areas.

In Namibia and southern Angola, there has been a trend of warmer sea surface temperatures which has led to changes in distribution of some inshore species of social and commercial importance. A further and potentially equally important challenge will arise from human population growth. All three countries already experience high levels of unemployment and food insecurity and, with the population in sub-Saharan Africa expected to grow from 770 million people in 2005 to between 1.5 and 2 billion people by 2050, pressure on all the continent's resources is going to escalate drastically.

The combination of onshore, offshore and deep-sea mining activities together with inadequate fisheries management[30] and practices[31] are considered the most important internal threats to the environmental health of the BCLME. Significant cumulative environmental impacts include:

- Alteration of food webs through reductions in biomass of targeted species and incidental catches, both predator and prey;
- Incidental catches of species of conservation concern including, for example, seabirds, sharks, sea turtles, and threatened finfish species;
- Damage to bottom substrates and ecosystems from bottom trawling and dredging;
- Impacts on water quality through discharges of oil, fish and other wastes from fishing vessels and processing factories, as well as pollution from heavy industries, desalination plants, towns and ships.
- Land degradation and deteriorating ecological functioning in catchments which support rivers that drain into the ocean (particularly the Orange, Kunene, Cuanza and Congo).

5.6. Mariculture

5.6.1. Current extent

The production and value of the mariculture sectors in all of the countries are much smaller than those from marine capture fisheries but are seen as important potential growth areas.

In the 1960's and 70s attempts were made to farm mussel (*Perna perna*) and tuna (*Authynnus alleteratus*) in Angola but these attempts were abandoned until the 1990s when the Marine Fisheries Institute (IIM) attempted to repeat the trials using Mediterranean mussel (*Mytilus galloprovincialis*). These trials were inconclusive due to problems of continuity. Potential for successful mariculture is still considered to be high and the Angolan government is pursuing the development of its aquaculture sector, including mariculture, as a contribution to its efforts to alleviate poverty. In 2004, a survey was undertaken by the National Fishery Research Institute together with the Artisanal Institute to identify suitable sites for aquaculture and in June 2005, a decree nº 39/05/ 6 for the development of aquaculture was approved by the

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[30] including inadequate transparency in setting of quotas and inadequate monitoring and policing
[31] Including high bycatch and illegal activities

Council of Ministers, followed by the Plano de Ordenamento das Pescas e da Aquacultura (decree nº 9/06). While aquaculture in Angola is still in the very early stages of development and at present is focused mainly on freshwater aquaculture (FAO National Fishery Sector Overview: Angola), there is considerable potential for mariculture along the Angolan coast including lagoons and mangrove areas. Indigenous species of shrimp and lobster may have potential for mariculture, while culture of mussels has been tested in Angola with positive results (DList Benguela[32]).

There has been some interest in, and development of the mariculture sector in Namibia but the harsh environment, including natural seabed sulphur eruptions and incidence of deoxygenated water, and a generally unfavourable coastline are serious hindrances. The current activities are focused on molluscs and are dominated by oyster production in Walvis Bay, Swakopmund and Lüderitz using Pacific oyster (*Crassostrea gigas*) and European oyster (*Ostrea edulis*) making use of baskets suspended from rafts, longlines and onshore raceways and ponds (FAO National Fishery Sector Overview: Namibia). The high productivity in the northern Benguela allows Pacific Oysters to attain a harvestable size in eight months as compared with 3 years in Northern Europe and Namibian oysters are also considered to be of high quality in Southern Africa where most of the production is sold (MFMR 2004). There is also some farming of mussels and abalone in Lüderitz (DList Benguela), as well as of *Graciliaria spp.* seaweed, with 30 tonnes having been produced by Namibia in 2008 (FAO, 2012).

Mariculture is currently highest in South Africa, although it is still on a very small scale compared to other major producers around the world. Currently abalone *Haliotis midae*, black and brown mussel *Mytilus galloprovincialis* and *Perna perna*, oyster *Crassostrea gigas*, prawn *Litopenaeus vannamei*, a variety of finfish species and seaweed are produced through mariculture in the country (FAO National Fishery Sector Overview: South Africa and Britz et al. 2009). There is a total of 36 mariculture production enterprises in the country of which 34 occur within the BCLME region: 5 in the Northern Cape, 18 in the Western Cape and 11 in the Eastern Cape.

Abalone is the most important of these species and it is estimated that South Africa supplies 21% of the global market for farmed abalone, of which 1,037 tonnes was produced in 2008 (the most recent estimate available). Abalone totally dominates the South African exports from aquaculture production and represented 82% of the total value of South African aquaculture production in 2008 (Britz et al. 2009). Abalone production takes place mainly on the Cape south coast in and around Hermanus. Production of other invertebrates in that year included 227 tonnes of oysters and 737 tonnes of mussels. Experimental culture of finfish is also taking place in the BCLME region including offshore cage culture of salmon off Gansbaai and pilot commercial production of dusky and silver kob (*Argyrosomus japonicus, A.inodorus*), yellowtail *Seriola lalandii*, and Atlantic Salmon *Salmo salar*. Cultured marine fish, dusky cod, produced by pilot ventures were sold for the first time in 2007 (Britz et al. 2009). Culture of seaweed *Gracillaria* also takes place using floating long-lines, rafts and, making use of effluent from abalone culture, in tanks.

[32] http://www.dlist.org/burning-issues/aquaculture-existing-aquaculture-activities#english accessed 1/10/2012

5.6.2. Future scenarios

There is great interest in all three countries to develop their aquaculture sectors, including mariculture. While there are a number of environmental, bureaucratic and economic constraints to rapid development, substantial increases in the number of enterprises, the area required for aquaculture and the total production in the region can be anticipated in the coming years. In the thirty years from 1980 to 2010, global aquaculture production grew by an average of 8.8% per year leading to a 12-fold increase in the thirty years. A very optimistic scenario could see similar growth rates in the BCLME region but these would ultimately encounter serious environmental constraints. To the best of the authors' knowledge, there has been no attempt to estimate the upper limit or environmental 'carrying capacity' for mariculture in the BCLME. Doing so as part of the SEA would be a positive contribution to the sustainable development of the BCLME.

Some of the regional advantages for aquaculture development include:

- Political support for mariculture development including the Plano de Ordenamento das Pescas e da Aquacultura in Angola and the Aquaculture Act, No.18 of 2002 in Namibia. An aquaculture policy is in the early stages of development in South Africa;
- Generally unpolluted and productive marine waters;
- Already well-established processing, packaging and marketing system established through the commercial capture fishery sector;
- Generally good infrastructure including telecommunications, although this does vary to some extent from region to region.

Some of the constraints to development include:

- A relatively exposed, high energy coastline along much of the BCLME region with limited sites suitable for existing *in situ* culture techniques;
- Incidence of toxic algal blooms, occurrence of deoxygenated water in inshore areas and, in Namibia, sulphur eruptions are important challenges;
- In Namibia, the high number of predators, seals in particular, has been highlighted as a problem;
- A lack of exposure to and familiarity with aquaculture in the region is limiting the interests of the wider business community and financial institutions in developing the sector;
- Related to the previous point, accessing affordable capital has been identified as an important constraint in Namibia and South Africa and is likely to apply to Angola as well;
- Difficulties in obtaining high quality and suitable food for the fish and seed (fingerlings);
- Inadequate availability of qualified personnel across all the specialisations required for aquaculture research, extension and effective management;
- Insufficient suitable land and sea spaces zoned and available for starting new aquaculture enterprises;
- The regulatory framework, including zonation, environmental regulatory requirements, permitting and others is frequently a hindrance;
- Inadequate capacity within law enforcement agencies and government authorities to prevent poaching (especially of abalone).

A survey undertaken on the status of aquaculture in South Africa provided some useful recommendations for promotion of aquaculture in that country, which are also broadly applicable to the region as a whole (Britz et al 2009). The recommended actions from the study were:

- The need to develop a national policy, strategic plan and implementation plan for the sector (most relevant to South Africa as the other two countries, especially Namibia, are further advanced in this regard);
- Improving access to finance;
- Strengthening available capacity in aquaculture through education, training and skills development;
- Strengthening capacity to monitor and guarantee the safety of the aquaculture products which is important for local markets as well as for the demanding international markets;
- Strengthening the capacity of law enforcement agencies to prevent illegal poaching and sale of abalone;
- Ensuring capacity for and availability of veterinary services for aquaculture;
- Ensuring availability of suitable, zoned areas for aquaculture development;
- Research, technology development and technology transfer to facilitate development;
- Promotion of aquaculture at all levels and amongst all current and potential stakeholders including customers and the public at large, including promotion of aquaculture products for trade;
- Promotion and implementation of best management practices.

Based on these drivers and needs, it is very likely that mariculture will grow in all of the countries and therefore in the region as a whole. The rate of growth is impossible to predict and will depend on a combination of government support and commitment and the willingness of the private sector to take on the challenges and take advantage of the opportunities.

5.6.3. Environmental Impacts

Table 5.4.8: Direct and indirect impacts of the mariculture

Main Construction Activities

- Construction of onshore shellfish processing facilities, jetties and offloading infrastructure
- Access roads and tracks
- Contractor's camp, yard etc.
- Waste disposal
- Construction traffic
- Labour force

Main impacts of Construction on the natural environment

- Direct loss of coastal/shore/bank vegetation and faunal habitat (main concern is clearing of mangroves)
- Temporary or permanent interruption of ecological corridors
- If not disposed of correctly, waste will affect marine and shoreline organisms.

Main Operational Activities

- Seeding and harvesting
- Launching, loading and offloading of small vessels
- Handling, storage, conveyance and transfer of fish (mostly shellfish)
- Fish processing (mostly cleaning)
- Disposal from cleaned fish
- Re-fuelling of boats (primarily small craft)

Main impacts of operations on the natural environment

- Introduction of alien species – some of which could become invasive
- Artificial feeding results in the addition of effluents to the environment which, if inadequately controlled, can lead to eutrophication.
- Insufficiently regulated and monitored aquaculture can also result in biosecurity risks which can include the introduction of disease to an area through importation of food for the fish and use of species or strains
- Impact of fuel spills on seabirds, marine, inter-tidal and shore organisms.
- Impacts of litter and waste on fish, marine mammals and shoreline fauna.
- Impacts on water quality and marine organisms from runoff and effluent disposal from fish processing factories.

Cumulative impacts

See 5.4.4 for discussion on cumulative impacts of mariculture and ports, particularly the spread of alien invasive organisms.

5.7. Catchment and estuaries management

5.7.1. Current extent

River catchments are areas of land defined by the common flow of water on them. All the rain that falls in a catchment flows down to a common area, like a river, and then eventually out to sea. Everyone lives in a catchment, so all the water waste produced in catchments eventually goes out to sea through rivers, stormwater and sewage systems. This means that coastal and marine systems are affected by many human activities on land that we may not think are connected to the ocean - pollution from industry, chemicals from farming, and sediment from deforestation of land and coastal erosion may all flow out into the sea and affect the ocean. With few exceptions, the catchments that drain into the BCLME are experiencing escalating development and land degradation. Moreover, the larger rivers have impoundments for water provision and/or electricity generation. The main catchments in the BCLME countries are depicted in figure 5.1.5.

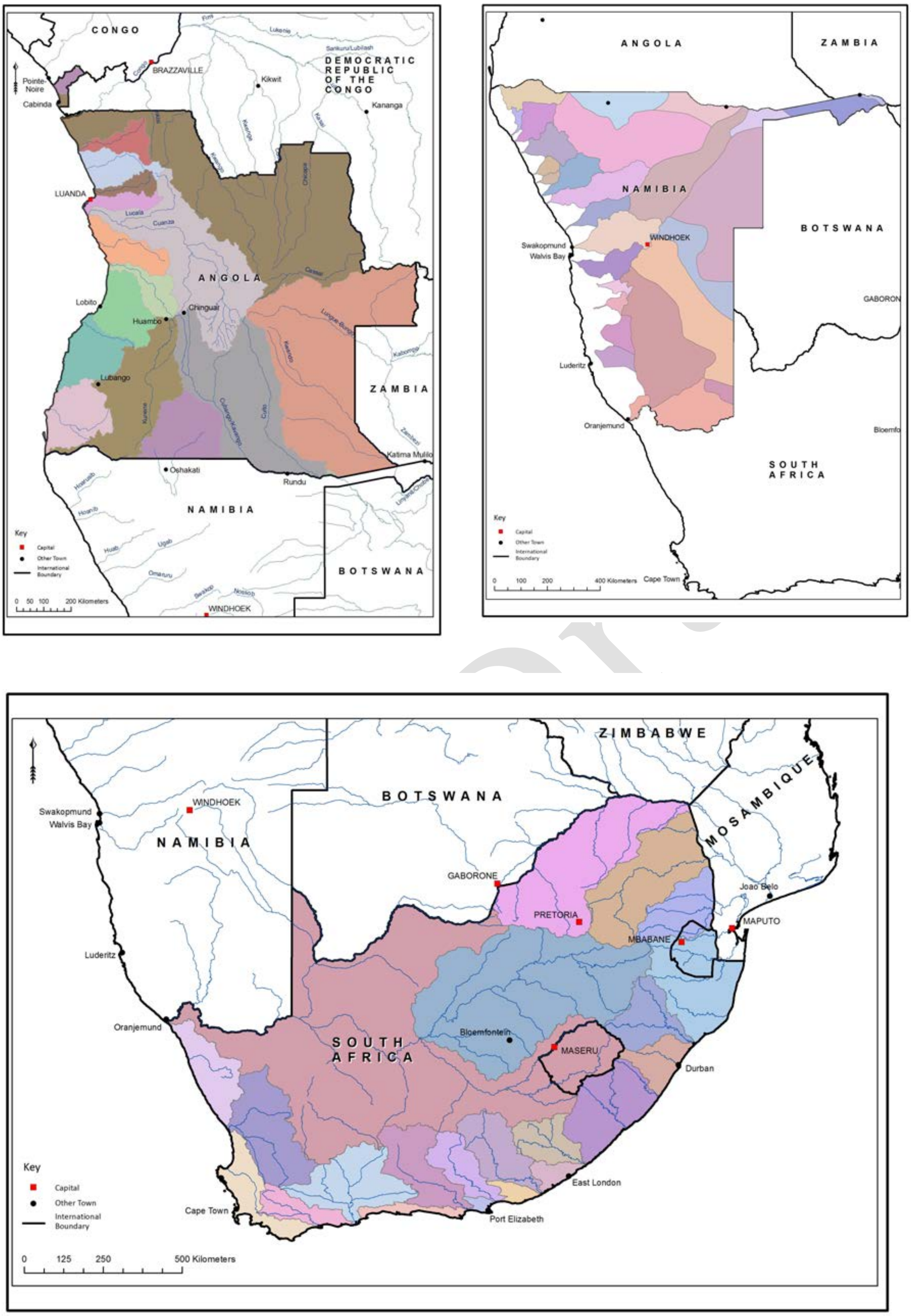

Figure 5.1.5: Catchments in Angola, Namibia and South Africa

Estuaries form a transition zone between river environments and ocean environments and are subject to both marine influences, such as tides, waves, and the influx of saline water; and riverine influences, such as flows of fresh water and sediment. The inflow of both seawater and freshwater provide high levels of nutrients in both the water column and sediment, making estuaries among the most productive natural habitats in the world. Thus, estuaries provide important habitats for coastal ecosystems.

- The Congo River, at the northernmost limit of the BCLME has a major impact on the ocean. Its influence can be detected over thousands of kilometers into the sea.
- Although the influence of the Orange and Kunene Rivers on the marine environment is minimal when compared to the Congo, their drainage basins include a large part of the southern African hinterland. The Orange River estuary offers an valuable refuge and breeding site for several fish species (Clark, 2010).
- In Namibia most of the rivers that reach the sea (with the exception of the Kunene and the Orange) are small and episodic and limited to extreme flood events. However some of these river systems do influence small coastal estuaries and lagoons e.g. the Swakop, Kuiseb and Hoanib Rivers.
- Approximately 40% of the flow from South Africa's 20 largest catchments no longer reaches the estuaries concerned (Sink *et al* 2011). This causes desiccation, increased salinity and changes in estuarine mouth dynamics which, in turn, threatens estuarine and marine habitats and biodiversity.
- The Orange drainage basin is 1 million km^2 and by far the largest catchment in South Africa. A 50% decline in river flow is estimated for the Orange River since 1935 as a result of increasing water demand (Clark 2010).
- During the past three decades yields of plant foods, fish and mammals associated with wetlands (including lagoons and estuaries) have declined noticeably in Namibia and throughout southern Africa (Barnard 1998, Turpie *et al.* 1999).

The preliminary TDA for the Orange was completed in 2008, providing a comprehensive analysis of land use within the catchment, water quality, changes to the hydrograph as a result on water use and impoundments, and the impacts of catchment management on the river mouth. The TDA is currently being updated.

5.7.2. Future scenarios and expected impacts

Water demand in all three BCLME countries is expected to increase. In Namibia alone water use is likely to increase by at least 250% between 2003 and 2030 (in NPC, 2001). The country's National Agricultural Policy aims for a five fold increase in irrigation (*ibid*) and this, together with increasing demand for water for domestic, mining and industrial users, will affect the flow regimes of most rivers and underground aquifers. New dams are planned in the Fish River (tributary to the Orange), the Orange River (main stream) and the Kunene (the latter for hydropower).

In South Africa there are a number of water transfer schemes that move water from one catchment via pumps, pipes and canals into another catchment. According to the Department of Water and Environmental Affairs, the demand for water will outstrip supply in Gauteng by 2013, and in the whole of South Africa by 2025 (www.waterwise.co.za/site/water/environment/situation.html).

In Angola the overuse of pastures and subsequent soil erosion attributable to population pressures; desertification; deforestation of tropical rain forest, in response to both international demand for tropical timber and to domestic use as fuel, resulting in loss of biodiversity; soil erosion contributing to water pollution and siltation of rivers and dams; inadequate supplies of potable water (www.indexmundi.com/angola/environment_current_issues.html).

5.8. Climate change

As a major reservoir and transporter of heat in the climate system, the ocean and its interactions with the atmosphere are at the root of the high climate variability experienced within the BCLME, the driver of the El Niño-Southern Oscillation (ENSO) and other naturally occurring climate phenomena which can have significant impacts on marine ecosystems and fisheries.

The naturally high environmental variability of the BCLME complicates understanding of the many potential impacts of climate change on the ecosystem (BCLME 2007 a) but, in general the following changes are expected with a high degree of certainty :-

- Increasing Sea Surface Temperature (SST) with associated changes to coastal wind regimes (this will effect biodiversity and ecosystem form and functioning).
- Continued sea level rise (SLR)
- Increased variability within the LME.

BCLME (2007a) reviews atmosphere climate records and biological data spanning the last 50 years, with the aim to gain insight into the nature of regime shifts in the BCLME. These shifts appear to occur with a decadal oscillation (a periodicity of 5-15 years). However it is difficult to unequivocally attribute these changes to either climate change or to inherent natural variability. For more detailed information on the effects of climate change on the BCLME, see Appendix C.

Global temperatures have risen since the 1850's and rates of change are becoming more rapid. Eleven of the twelve years in the period 1995–2006 rank among the top 12 warmest years since 1850 (IPCC, 2007). Observations since 1961 show that the oceans have been absorbing more than 80% of the heat added to the climate system, and that ocean temperatures have increased to depths of at least 3000 m. When investigating future vulnerabilities and impacts of climate change, the IPCC considers six possible GHG emissions scenarios which span a range of projected temperature and sea level rises from a best estimate average temperature rise of 1.8 °C (accompanied by a sea level rise of 18 to 38 cm), to a best estimate average temperature rise of 4 °C (accompanied by a sea level rise of 26 to 59 cm) for the 2070 - 2080 decade [33].

[33] The most up to date research on climate change in Namibia (as presented in Turpie *et al* 2010) is based on the A1B emissions scenario. This research draws on the outcomes taken from several General Circulation Models (GCMs) that were updated for the IPCC's Fourth Assessment Report (AR4). Because levels of uncertainty in projections (and particularly variability in current precipitation regimes) are so high, these authors, instead of looking at just one or two models, took the average of 21 GCMs, which presented a range of high, median and low climate predictions.

Impacts of Sea Level Rise

Warming causes seawater to expand, which contributes to sea level rise. Sea level rose by an average rate of 1.8 mm/year during the years 1961-2003 (IPCC, 2007). Research conducted in southern Africa from 1959 – 1990 show trends in SLR that are comparable to global trends (Hughes et al 1991; Hughes et al, 1992). Rates of SLR appear to be increasing. The IPCC's predictions for SLR (a best-estimate rise of less than 2 mm per year) were considerably lower than the actual rise (3.3 mm /yr), which occurred between 1993 and 2006 (Rahmstorf et al, 2007).

The areas most susceptible to SLR are heavily populated megadeltas/esturies (including Cabinda and Luanda) and the offshore islands important for bird breeding. In comparison most of the BCLME's coastal towns and cities are not considered to be 'hotspots' for the impacts of SLR, however local authorities will still need to pay cognisance to the fact that low-lying coastal areas and sand and gravel beaches are likely to experience significant impacts as a result of climate change.

Nicholls et al (2007) report that local sea-level change could depart significantly from global mean trends due to variations in oceanic level change and local geological uplift/subsidence. Coasts subsiding due to natural or human-induced causes will experience larger relative rises in sea level. Storm intensity is likely to increase at coastal localities throughout the world, with more extreme high-tide events. Models suggest that both tropical and extra-tropical storm intensity will increase around the world. This implies additional coastal impacts than attributable to SLR alone, especially for tropical and mid-latitude coastal systems. There is expected to be an increase in climatic variability in future decades. Thus, despite an overall periodic heavy precipitation events are likely to become more common. This will increase flood risk on all ephemeral and perennial rivers within the BCLME.

Climate drivers and their main biogeophysical impacts

A range of coastal responses can be expected for the BCLME coastline as a result of SLR (Table 5.4.9). These include biogeophysical effects such as:- increasing rates of coastal erosion; increased flooding, inundation and displacement of wetlands and lowlands; impairment of water quality into freshwater aquifers and estuaries due to increased salt intrusion; and reduced protection from extreme storm and flood events.

The rate, magnitude and direction of sea-level change will vary considerably due to local alterations in ocean conditions and vertical movements of the land. In addition, the actual response of coastal zones and systems to these changes will differ substantially according to local geomorphic conditions and sediment supply.

Table 5.4.9. Selected climate drivers for coastal systems and their main effects. (Trend: ↑ increase; ? uncertain; R regional variability). [Source: Adapted from Nicholls et al, 2007].

Relevant climate driver	Main effects on coastal systems
Sea level (↑, R)	Inundation, flood and storm damage; Coastal erosion; saltwater intrusion; rising water tables/impeded drainage; wetland loss (and change).
Storm intensity (↑, R)	Increased extreme water levels and wave heights; increased episodic erosion, storm damage,

	risk of flooding and defence failure.
Storm frequency (?, R)	Altered surges and storm waves and hence risk of storm damage and flooding.
Wave climate (?, R)	Altered wave conditions, including swell; altered patterns of erosion and accretion; re-orientation of beaches.
Run-off (R)	Altered flood risk in coastal lowlands; altered water quality/salinity; altered fluvial sediment supply; Altered circulation and nutrient supply.

Socio-economic consequences of climate change on BCLME coastal settlements

Coastal settlements in the BCLME are economically dependent on mining, tourism, fisheries, and other industries. All of these activities will all be affected to one degree or another by the impacts of climate change. Of these, the most pertinent to the local authorities (LA's) of coastal settlements and cities will be the impact on freshwater supply and infrastructure.

Table 5.4.10. Summary of climate-related impacts on socio-economic sectors in coastal zone (adapted from Nicholls et al, 2007).

	Climate-related impacts (and their climate drivers)						
Coastal sector (1) = of primary concern for LA; (2) = of secondary or no concern for LA	Temperature rise	Extreme events (storms, waves)	Floods and inundation (SLR; runoff)	Rising water tables (SLR)	Erosion (SLR storms, waves, sedimet changes)	Salt water intrusion (SLR; runoff)	Biological effects (all climate drivers)
Freshwater availability (1)	X	-	-	-	-	X	-
Fisheries and aquaculture (2)	X	X	x	–	x	X	X
Health (1)	X	X	X	x	–	X	X
Recreation and tourism (2)	X	X	x	–	X	–	X
Biodiversity (2)	X	X	X	X	X	X	X
Offshore diamond mining (2)	-	X	-	-	X	-	-
Settlements/ infrastructure (1)	x	X	X	X	X	X	–

X = strong; x = weak; – = negligible or not established.

Of major concern for all coastal settlements particularly in Namibia, southern Angola and the Northern Cape Province of South Africa - will be the provision of water. Even in the absence of climate change, water demand in Namibia (dictated by the expansion of irrigation and mining projects as well as the domestic demands of a rapidly expanding, urbanising population), is expected to surpass the installed abstraction capacity by 2015 (in Dirkx et al. 2008).

The scale of salt-water intrusion of coastal aquifers will depend on the size of the aquifer, geological factors, groundwater withdrawals, surface water recharge, submarine groundwater discharges and precipitation. Salinisation of surface waters in estuaries will also be exacerbated by SLR (e.g. at the Orange River mouth). A preliminary study conducted for Walvis Bay almost 20 years ago (Hughes et al 1992), can be used to illustrate the potential impacts of climate change on Namibia's coastal settlements (see box below).

Box:- Vulnerability of Walvis Bay to the effects of sea-level rise

Hughes et al (1992) investigated possible impacts due to increased erosion, flooding, elevated water tables and salt pollution and extreme storm events for sea-levels elevated 20cm, 50cm and 100cm above 1991 levels[34]. Walvis Bay is particularly vulnerable to the impacts of climate change – because it is low lying (average relief of between 1m and 3m above mean sea-level), and because of the possibility of the increasing occurrence and intensity of flooding by the Kuiseb River. The adjacent coastline is soft, sandy and erodible. The town relies on coastal aquifers for water. Rainfall is usually in the region of <20 mm per annum.

The main conclusions of the study are summarised as follows :-

Erosion. The effect of increased coastal erosion is likely to have limited impact on the town because development in the most vulnerable built up area (adjacent to the lagoon) is no longer permitted.

Salt water intrusion. Unsustainable abstraction of freshwater from the Kuiseb aquifer is likely to result in salt water intrusion. Rising sea-levels will exacerbate this effect but the proposed development of desalination plants and consequent reduced abstraction from the aquifer should mitigate these effects.

Storminess. Under even the lowest sea-level rise scenario used in this study, parts of Walvis Bay are expected to become extremely vulnerable to the effects of higher, storm induced coastal water levels. A future 1 in 10 year storm, after a 20 cm rise in sea-level, would attain a higher water level than that which could be reached by a 1 in 1000 year event in 1991.

Flooding and Inundation. Any rise in the water table from its 1991 position at about the MHWS level (0.71 m elevation) will have serious consequences for the town. Undoubtedly the tidal volume of the lagoon will increase but this is likely to be offset by the ongoing sedimentation of this wetland. A lack of accurate knowledge regarding rates of sedimentation in the lagoon precludes a realistic delineation of those areas that are at risk except to say that, under the three scenarios (a rise of 20 cm, 50 cm and 100 cm), unprotected land below 0.9m, 1.2m and 1.7m elevation respectively, is vulnerable to inundation. Changes in saline groundwater levels under the town are likely to match changes in sea level. Thus, those low-lying areas vulnerable to inundation will be vulnerable to water logging even if shore protection work is carried out. For example: A 20 cm sea-level rise will cause areas lying below 0.9m, (e.g. the hospital and primary and secondary schools) to flood at high tide. A 50 cm rise will flood a greater area of the town and harbour. This will affect production in the salt works and is likely to cause engineering and pollution problems in areas like the cemetery and sewerage works which all lie at approximately 1m above mean sea level. A 100 cm rise is likely to flood the majority of the town below 1.7m elevation during high tide.

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[34] Based on a rough estimate for global sea-level rise since 1991 - 2006, sea levels have risen off the Namibian coast by approximately 5 - 6 cm. At an average rate of SLR of 3.3 mm/year, a 20 cm rise can be expected by 2050.

The long timescales of sea-level rise suggest that coastal management, including spatial planning, needs to take a long-term view on adaptation to sea-level rise and climate change, especially regarding long-life infrastructure (e.g. industrial parks).

Differences in geological and oceanographic processes will lead to substantially different impacts on coastal systems at different localities. As there is not a simple relationship between SLR, increased occurrence of high storm events and coastal erosion, a specialist SLR Risk Assessment (such as that conducted for Walvis Bay) should be conducted for each coastal town. A Risk Assessment of this nature will combine local land survey and geomorphological information with a range of up to date SLR scenarios, and is strongly advised as a foundation for all future town planning. Coastal erosion can be extremely costly and accounting for the full range of costs can be difficult. The IPCC (2007) suggest that studies, in addition to identifying vulnerable areas, should also consider:-

- Appropriate shoreline protection (e.g. beach nourishment, hard protection or other responses) where rates of shoreline retreat are likely to increase;
- The long-term cost and sustainability of such interventions; and
- Whether insurance (or other factors) provided by the public and private sectors encourage people to build, and rebuild, in vulnerable areas.

The IPCC reports that one constraint to successful management of climate-related risks to coastal systems is the limited ability to characterise in appropriate detail how coastal systems, and their constituent parts will respond to climate change drivers and to adaptation initiatives (Nicholls et al, 2007). This lack of understanding of coastal systems, including their highly interactive nature and non-linear behaviour, means that failure to take an integrated approach to defining climate-related risks increases the likelihood that the effectiveness of adaptation will be reduced, and perhaps even negated. Since it offers advantages over purely sectoral approaches, integrated coastal zone management (ICZM) is widely recognised and promoted as the most appropriate process to deal with climate change, sea-level rise and other current and long-term coastal challenges.

6. SEA Terms of Reference

6.1. Introduction

It is increasingly obvious that negative environmental impacts in the BCLME not only result from direct, indirect and cumulative impacts from development projects, but also from various forms of resource-use over time and a number of external factors. Also, it is evident that impacts originate from activities both in the marine environment, the coastal area, and from projects far inland in the various river catchments that are linked to the ocean. A major constraint in understanding the significance of the various impacts, is the fact that the BCLME is highly complex, poorly understood and many types of impacts are difficult to predict.

It is intended that this SEA will provide a robust evaluation of the cumulative impacts of current and future development and a variety of traditional land use activities. The assessment of cumulative impacts recognizes that each additional project may represent a high marginal cost to society and the environment, and that individual projects cannot be considered in isolation. Cumulative effects analysis is thus an important component in SEA, particularly when decision makers need to assess the full or "true" impact to society of a proposed policy, plan, programme or project.

SEA provides opportunities for positive planning and opens the door for co-operation and integration between different countries, agencies and organisations with the shared objective of sustainable development. Co-operation between government agencies and other stakeholders within the BCLME is of the utmost importance to set a firm foundation for sustainable development and for meeting the Millennium Development Goals. Co-operation enables shared objectives and desired outcomes of planning, assessment and decision making. All of the authorities and other stakeholders in the BCLME should make a commitment to accepting, implementing and promoting the integration of the findings of the SEA into future land/resource use and strategic planning processes. In practical terms, implementation will be at national and sector levels.

The conducting of an SEA does not rule out subsequent project-level EIAs. Even though the SEA might set development parameters (e.g. seabed mining best practice.), individual projects with potential to cause significant environmental impacts will still need an EIA, so that the project takes cognisance of site-specific circumstances. When impact assessment is tiered in this way, a big, consolidated and integrated effort goes into the SEA while the subsequent EIAs (which could be many in number) require relatively less effort, cost and time.

The primary objectives for the SEA of the BCLME are to:

- Identify (at a strategic level) the most vulnerable ecological processes, natural habitats, wildlife and human communities that are most likely to be affected by current and likely future developments and activities;

- Identify the most significant direct, indirect and cumulative environmental[35] impacts of current and expected future developments and activities in the BCLME and their implications (e.g. opportunity costs) on other economic activities and development options;

- Share information on important issues arising from current and likely future developments and resource use with decision-makers and planners at national, regional and local government level, within the private sector (and parastatals), civil society organisations, environmental practitioners and planning consultants;

- Improve awareness[36] about the management and implementation of environmental safeguards and general planning tools;

- Strongly encourage, through the Strategic Environmental Management Plan (SEMP), the application of best practice in planning and land/resource use by government, developers, local communities and others, so that there is equitable, long-term and sustainable development for all sectors in the BCLME.

- The outcomes of the SEA will be hosted on a Geographical Information System (GIS) platform to enable uniformity of design of data collation, management and storage, and to facilitate decision making at all levels by the various stakeholders.

6.2. SEA and Scope of Work

Traditionally, a SEA is the application of impact assessment to policies, plans, and programmes. There are many different approaches to a SEA: one is the 'EIA' model where the impact assessment is carried out on a policy, plan or programme once it has already been developed (i.e. reactive). Another is an integrated and/or 'sustainability led' approach that strives to meet sustainable development objectives. This is more proactive and can be integrated into policy and planning processes. Importantly, SEA encourages an 'opportunities and constraints' type approach to development, where such things as natural resources and ecosystem services at landscape scale define the 'framework' within which development can or should take place and the types of development that could be sustained. Whilst all the main sectors that utilise the BCLME have been doing so for decades or centuries, all either have plans for the future or they may be developing them at some point. Thus, this SEA will need to combine reactive and proactive approaches.

However, the broad scope and low level of detail of the SEA must be complemented by the narrow scope and relatively high level of detail of the individual project EIAs. Thus in order to ensure that projects meet the objectives of sustainable development, it is important that the impact assessment of a project is 'nested' within the SEA, thus ensuring that it is contextually sound and consistent with broader development objectives.

[35] broadly defined to including social, biophysical, health, institutional, economic and all other components of the environment
[36] amongst all levels of decision-making, including political, local government, corporate, administrative and civil society

Where a particular geographic area (e.g. the BCLME) is experiencing rapid development and/or additive impacts, the SEA provides a framework within which to evaluate the cumulative impacts of current and future development. Cumulative impacts are best addressed at a landscape, regional or sectoral scale through SEA, with project level EIAs providing greater focus and detail.

Impact assessment and decision-making are influenced by international conventions, national policies and laws, and a host of socio-economic imperatives. However, it must be informed by both scientific and local knowledge gathered during the impact assessment process, (Figure 1).

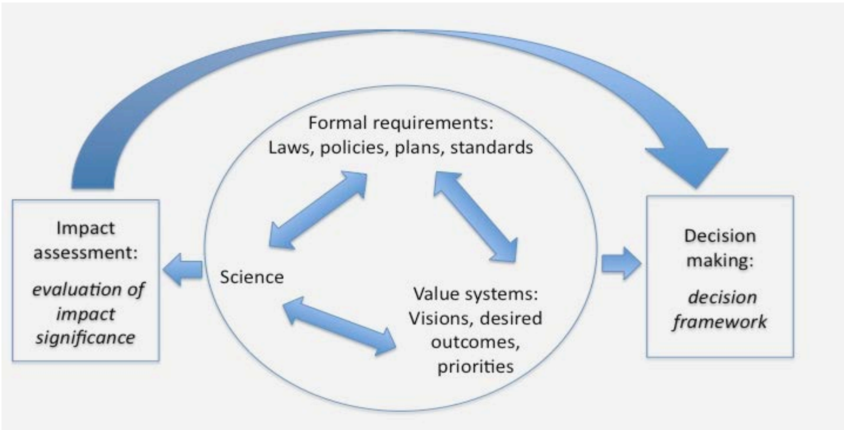

Figure 1: Science, values and regulatory frameworks (source: Brownlie et al 2009).

Theoretically, society's values are reflected by policies and laws, but value systems change in response to new information and evolving cultures. As noted by Brownlie *et al* (2009) and illustrated above, impact assessment and decision-making must consider both science and value systems.

One of the difficulties in SEA is to understand and decide what process to follow as methodologies are still evolving and best-practice examples are rare. In spite of the wide variation in application of SEA, all 'good practice' SEAs should comply with the following key principles (modified from DEAT 2007).

Integration	• Due to the national and regional implications of resource-use practices in the BCLME, this SEA must take an integrated, regional perspective. • EAs of all strategic decisions relevant for the achievement of sustainable development, are needed • Interrelationships between biophysical, social, economic and institutional (including policy) aspects must be understood • There needs to be a tiered approach, linking legislation, policies and programmes and, where appropriate, achieving a continuum between the SEA and project level EIAs, administration processes and decision-making.
Sustainability-led	• The SEA process must facilitate the identification of development options and alternative proposals that are sustainable, or that significantly promote sustainability.

Focused	• Sufficient, reliable and usable information is needed for development planning and decision-making • There must be a focus on key issues relevant to sustainable development • The SEA process must take into account the characteristics of the decision-making process in the area/country • The process must be cost effective and efficient.
Accountable	• The authorities and/or other key decision makers must take ownership over the process and assume responsibility for decision making at defined levels • The process must be carried out with professionalism, rigor, fairness, impartiality and balance • The process must be subject to independent checks and verification • The process must be documented so that it is clear how sustainability issues were taken into account and how they influenced decision-making.
Participative	• Interested and affected parties (public and private) must be involved throughout the SEA process • Public inputs and concerns must be thoroughly considered in decision-making • Clear, pertinent and easily understood information must be provided to the public early so as to enable their timeous and effective involvement.
Iterative	• Assessment results must be available early enough to influence the decision-making process and inspire future planning (and where possible, halt or reverse poor current planning/practices) • Decision makers must commit to fully considering the implications of all reasonable development options so that strategic decision making contributes positively to the achievement of sustainable development.

It will be fundamental to establish a sound baseline understanding of the biophysical, socio-economic and institutional contexts within the area[37]. This will serve to inform decision-making and highlight sensitive or vulnerable areas needing particular avoidance, mitigation or management (e.g. capacity within institutions, ecological thresholds, vulnerable habitats, etc). The SEA needs to inform a SEMP for the BCLME. This SEMP must be for decision makers and all major stakeholders and not just developers.

The SEA will be conducted and implemented in a number of phases, as outline in the figure below.

[37] Some information already exists from previous BCLME work.

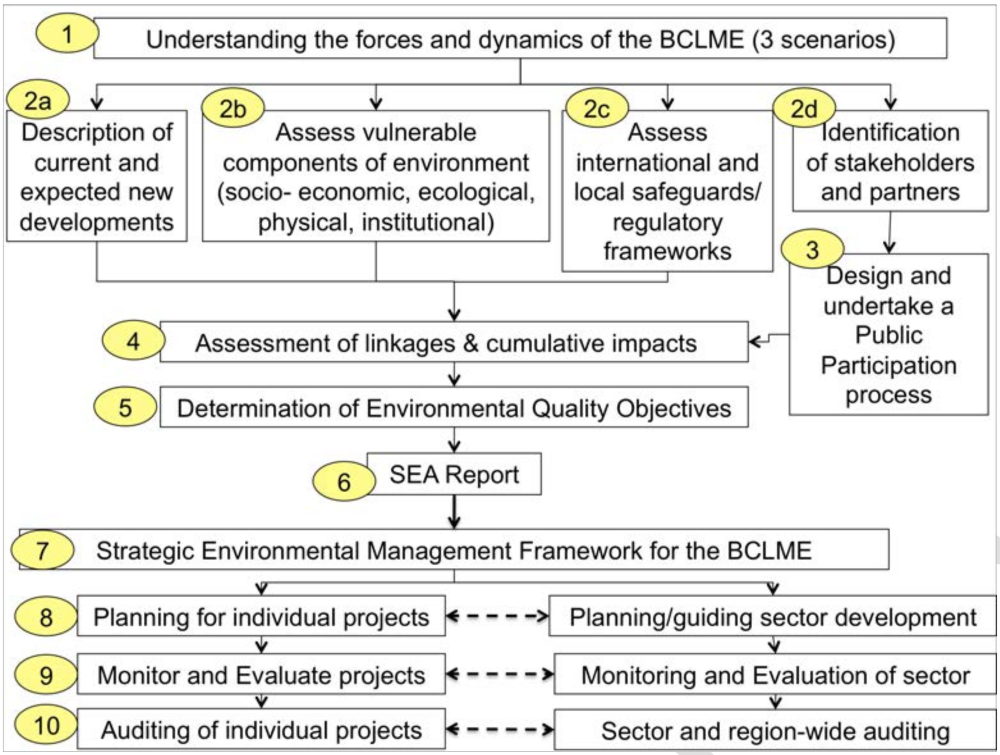

Figure 2: Schematic outline of SEA sequence of activities

Fundamental to the success and sustainability of the SEA will be the management and implementation of the programme of work and the auditing, evaluation and monitoring procedures that are established throughout the process. The SEA will therefore be undertaken in a more-or-less sequential way, with each step building on the previous one. However, some activities (e.g. step 1 and 2(a) could be done in parallel).

Step 1: Understanding the "Forces and Dynamics" on the BCLME

When conducting an SEA of a large and complex area that supports multiple development sectors as well as traditional land use, we need to appreciate the broader forces that determine how the area may evolve in the foreseeable future. It requires the construction of at least three scenarios that could become reality in a 10-15 year time horizon, depending on how external and internal factors play out.

Macro-economic issues, market trends relevant to southern Africa and the BCLME countries, business opportunities and other global trends, as well as an understanding of internal opportunities and constraints, provides a useful background for further analysis about the sustainable development options for the BCLME countries, and their social and environmental implications. The following list provides some examples[38] of global, regional, national and local factors that could affect future development trajectories for the BCLME:

Global	Regional	National	Local

[38] This list is merely indicative – designed to provide ideas for further elaboration by the SEA team

• Economic crisis in Europe and USA will suppress export markets (e.g. oil, fish, minerals) • Continued growth of Chinese economy may improve viability of some mineral prospects • Continued investment by China in the development of infrastructure and mineral resources in Sub-Saharan Africa • Climate change may alter wind patterns and currents, affecting upwelling and productivity.	• Political instability in surrounding countries may affect tourism and trade negatively, • Alternatively, peace and prosperity in neighbouring countries may improve the regional economic environment, and result in more cross-border trade. This may increase shipping, port traffic and associated developments • Changes in customs requirements, visas and tax agreements within SADC and especially between the BCLME countries may help promote (or alternatively, stifle) cross-border trade and investment	• National policies, plans and programmes (e.g. food security, energy self sufficiency, economic liberalization, decentralization, etc.) will all likely have an effect on the way the BCLME will develop – these PPPs need to be well understood • A decision to upgrade ports and increase regional shipping will likely stimulate economic growth • Allocation of sufficient funding to economic sectors (e.g. tourism, mining, power, manufacturing, oil and gas exploration, agriculture) will likely have a spin-off in the BCLME	• Local health factors (e.g. HIV and AIDS) may limit growth potential • Under-investment in physical and service infrastructure (e.g. ports, power supply and hotels) will likely limit future growth potential in almost all sectors (adequate investment obviously has opposite effect!) • Competency (or otherwise) at local authority level will likely affect competiveness of the area to attract and maintain investments. • Trends in ecosystem health will affect viability of most sectors that rely on resources such as water, fish, etc. • Under-investment in education and skills development will limit the opportunities for local investment by local communities

It is not possible to complete step 1 until step 2 has also been concluded, because constructing scenarios requires an understanding of both past trends, the current situation and then the analysis of possible futures as described above. Therefore, steps 1 and 2 are not sequential, but concurrent.

Step 2 (a): Assessment of resource/landuse and development in the BCLME

This step includes a number of concurrent activities[39], including a description of current and expected new activities (e.g. plans, programmes and projects – and informal activities) in the BCLME, an assessment of the vulnerable components of the environment, the availability/status of international and local safeguards/best practice. This information needs to quantified as much as possible and depicted on maps, graphs, etc.

Fundamental to this is an understanding of how various development sectors operate, including process requirements, waste, land, water and power requirements, need for labour, skills and expertise, markets, and (if applicable)

[39] Examples of activities include mining, hydro schemes, fisheries, mariculture, tourism, etc.

closure plans, rehabilitation and environmental restoration. At the very least, there must be an accurate assessment of the following in the case of each major sector[40]:

- Rates of harvesting of living marine resources, and how these correlate with stock assessments and past trends;
- Methods of harvesting living marine resources, and the extent to which bycatch is expected/likely;
- Extent of dredging required (e.g. for port development), where the dredged materials are/will be dumped, and approximate composition of spoils;
- What chemicals are/likely to be used in the various industries, where are/will they be obtained and how they are/will be transported, stored and disposed of;
- How much waste is/will be generated and how this is/will be managed;
- What infrastructure will be developed (roads, housing, sewerage systems, pipelines, powerlines, schools, clinics, waste disposal sites, storage and packing facilities, etc.);
- The phases of the various projects, including anticipated closure (if applicable);
- How much water and power will be used and where it is/will likely come from;
- How many employees and service providers are/will be required (and where they might come from – or already live in nearby towns);
- The plans for funding the implementation of environmental safeguards and closure;
- The existing/planned stakeholder forums between the various projects and the public (if any);
- The existence/planned environmental consultants (or in-house team) which the projects use/will use to help them monitor environmental impacts and management throughout the life of mine (and beyond if appropriate).

Given that some of the impacts in the area are generated by informal activities (e.g. recreational and artisanal fisheries), it may be necessary to make an aggregated assessment of the impacts based on expert opinion and/or existing reports. This Scoping Report provides a brief, initial analysis which should be regarded as a 'starter pack' for the task ahead.

Step 2(b) Assessment of the vulnerable environments in the BCLME

The receiving environment includes biophysical, social, heritage, infrastructure, institutional, economic and other components. It is important for the SEA to consider developments in the context of the following:

- Proximity to protected natural and heritage areas – their status, their objectives and their existing/emerging management plans;
- Proximity to vulnerable/threatened/protected species, communities, and sensitive landscapes (whether in or outside protected areas);
- Nature of ecological processes and importance of ecological services in the area likely to be affected by development;
- Extent of synergies or antagonistic impacts, especially opportunity costs;
- The current and likely future demands on labour, water, land, power and other critical resources.

[40] Because of key differences between many of the development sectors in the BCLME, some of the bullet points suggested may/may not be relevant.

In many cases, the abovementioned components of the environment may already be strained, so a careful assessment is required to see which are likely to 'collapse' or deteriorate. In this regard, the SEA should provide:

- A succinct assessment of the current 'state of the environment' for as many components of the environment as possible;
- Thresholds for as many ecological processes, community/species functioning and environmental attributes as possible. If it is impossible to determine thresholds, then Environmental Quality Objectives should be proposed (see Step 5).

The SEA team should bear in mind that high unemployment rates in BCLME countries will likely result in an influx of job-seekers to the coast (particularly Namibia and Angola) if coastal areas continue to develop rapidly. This will place strain on physical and social infrastructure and management systems (Luanda being a prime example). It is likely that most of the job-seekers will occupy informal settlements, thereby contributing to overcrowding, disease proliferation, crime and social tensions. It is difficult to assess the vulnerability of this component of the environment, but information on HIV/AIDS and other diseases, population densities, crime, unemployment, etc. should enable some assessments to be made.

Step 2(c): International and local safeguards and regulatory frameworks

A number of laws, policies, standards and guidelines exist both internationally and in the three BCLME countries to guide development. Decision makers need a good understanding of what these are, how they relate to each other and the implications for the countries' respective local and international commitments. Much of this information exists in existing documents (including a summary in this document), but it needs to be updated, synthesized and contextualized in the SEA. Consideration should also be given to World Bank/IFC environmental criteria and guidelines, where appropriate.

Step 2(d): Identification of stakeholders

Pro-active stakeholder (including the public) engagement is required throughout the SEA process. Whilst stakeholders will be located throughout the BCLME countries, the rule of thumb is that those people directly affected have more say than those who are merely interested parties. A special effort must therefore be made to engage key stakeholders[41] along the coast throughout the SEA process.

A number of previous EIAs for existing projects in the BCLME countries have included stakeholder consultation, so lists of I&APs are already available. These lists should be obtained and refined according to the specific needs of the SEA. It is very likely that additional stakeholders need to be identified (particularly in Angola), as the scope of the SEA is somewhat different to that of the previous project-specific EIAs.

Step 3: Design public participation process

Effective stakeholder engagement in, and independent review of, an SEA are critical ingredients in assuring its quality. To be successful, a SEA requires commitment

[41] It is not realistic to consult every individual, but be sure to consult key stakeholders or their recognised representatives

from a variety of stakeholders e.g. politicians, senior management, government officials from all interested and affected departments, community representatives and non-governmental organisations. Thus, a credible public participation process (PPP) is fundamental to this SEA.

This step builds on step 2(d) and entails planning how best I&APs will be engaged throughout the SEA process and beyond. For example, it should identify the stages in the process when I&APs should be engaged, what methods will be used to engage them, and whether there will either be information provision, consultation or negotiation with them (or a combination of all three). Step 3 must also lead to a clear understanding of what resources are needed for the PPP. Some ideas[42] for providing information to the public and engaging the public in two-way processes include:

- Use of radio and other media (to provide information or advertise upcoming meetings or participation opportunities);
- General public meetings (town-hall type gatherings, which enable anyone to gain access to the information, but they have limited value in terms of real participation);
- Focus-group meetings (these will be very useful when engaging coastal communities, the fisheries and tourism sectors, local authorities, etc.);
- Village-level meetings – not necessarily each and every village, but a good sample in order to disseminate information and gather stakeholder input;
- Meetings with vulnerable/marginalised groups (e.g. artisanal fishers).

For guidance on best practice in public participation in EA, please visit www.saiea.com and follow the linkages to the "Calabash Project".

Step 4: Assessment of linkages, cumulative impacts and avoidance, mitigation and enhancement measures

This is the crux of the matter. Governments and other stakeholders must fully understand how all the different activities, both on their own and in combination, will impact (either positively or negatively) upon the receiving environment.

There is no single best method to assess the cumulative impacts and the synergistic and antagonistic effects of a Policies, Plans, Programmes and Projects on the environment and so approaches should be selected based on the issues at stake and the nature of the development(s). Tools include:

- Use of GIS (particularly mapping of trends and vulnerable areas);
- Cost-benefit analysis (including assessment of opportunity costs);
- Causal loop or causal chain analyses to determine the main causes of impacts;
- Linkage diagrams, which try to plot the main positive and negative links between causes and effects and which highlight unintended consequences and cumulative impacts (positive and negative);
- Comparative risk assessment, etc.

In this case, using a matrix to test the cumulative impacts of various sectors against sensitive environmental aspects might be a good way to get an initial overview,

[42] This list is not exhaustive

followed by the drawing of linkage diagrams so that intended and unintended consequences of actions may be understood.

Key cumulative impacts could be negative:

- Marine Pollution from industrialisation, desalinisation, seabed mining, dredging, shipping/rig accidents, agricultural run-off, urban waste discharge, shipping waste, etc. (with resultant habitat and biodiversity losses, associated opportunity costs and job losses, loss of future livelihood options);
- Habitat alteration from dredging, seabed mining, bottom-trawling, coastal development, damming of rivers and land reclamation (results as above);
- Fish stock collapses from over/inappropriate fishing (with resultant job losses, opportunity costs, loss of future livelihood options and disappearance of fish predators such as certain seabirds, seals, dolphins and other fish species) – the combination of overfishing and marine pollution (from various sources) is probably the most serious cumulative impact needing further analysis in the SEA;
- Alteration of coastal processes (e.g. sediment movement) due to construction in the coastal zone, coastal armouring, land reclamation, coastal mining;
- Strain on social services and infrastructure (hospitals, clinics, schools, crime prevention), as a result of influx of people to coastal towns;
- Deterioration of and/or congestion of physical infrastructure (e.g. ports, municipal facilities, communication networks);
- Damage to heritage resources (mostly through coastal developments);
- Visual impacts and loss of sense of place (resulting in loss of tourism potential) – the cumulative result of unsightly urban developments, industrial projects, litter/waste, habitat destruction (e.g. mangroves and beaches).

and also positive:

- Economic stimulation;
- Socio-economic improvements;
- Improved scientific knowledge
- Skills and capacity development;
- New and/or improved social and physical infrastructure.

Central to the assessment of cumulative effects is the need to quantify the current level of impacts in order to better predict future trends. Some of the aspects identified during this scoping study which need further research in the SEA include the following:

- Current and estimated future volume of marine traffic by type passing through the BCLME per year;
- Volumes of various liquid, solid and gaseous wastes and emissions produced by shipping per year and the disposal thereof;
- Ratio of urban/resort development to coastline length;
- Coastal population density and total;
- Ballast water risks;
- Combined industrial waste water discharges (brine, hot water effluent, etc);

- Combined urban stormwater runoff volumes;
- Combined dredge quantities (mining, harbours);

  Etc???

The assessment of cumulative impacts is essentially a continuation of step 2, where an understanding of the receiving environment was obtained. Having done this, the impacts can be assessed. Once the impacts are understood, the SEA must propose measures as to how they can be avoided/mitigated (or enhanced if they are positive impacts), in a similar way as is done in a normal project-level EIA process. The main difference is that avoidance/mitigation/enhancement measures must take into account the desired future state of the BCLME. A key value of an SEA (as compared to a project-level EIA) is that the SEA may have greater scope in proposing alternative ways of achieving desired outcomes (like sustainable development) than those already articulated by existing development proponents. Also, the avoidance/mitigation/enhancement measures will be broad-brush initially, gradually becoming more detailed as we move closer to project-level activities.

In all cases, addressing negative impacts must follow the following hierarchy: impact avoidance, mitigation (e.g. rehabilitation and restoration), offsets and, as a last resort, financial compensation.

Step 5: Determination of Environmental Quality (sustainability) objectives

The formulation of sustainability (or environmental quality) objectives is important because it provides clear statements of intent and indicates the desired direction for the BCLME. EQOs thus provide a methodological 'yardstick' against which the positive or negative effects of the various land/resource-use types (and different projects) can be tested. These objectives also guide the SEA process in terms of the level of detail and type of information or data that is required.

The EQOs can be derived from various sources such as WHO standards, local development parameters, Biodiversity Strategy and Action Plan goals, State of the Environment Reporting system, etc.

EQOs should also reflect the extremes of environmental quality (biophysical, social, sense of place, etc.) beyond which society would find further change unacceptable. An inherent aspect of setting EQOs is determining thresholds (or limits of acceptable change - LACs), which are defined as the point at which irreversible or serious damage could occur. Thus, EQOs are a combination between a desired common future as well as a limit on what negative impacts would be allowed.

In spite of time and other resource limitations, we should strive to set LACs based on reasonable scientific confidence. Public opinion and best available expert knowledge may suffice for some issues, but others may require more data gathering in order to improve confidence limits. Either way, EQOs and LACs may be adjusted over time as our knowledge improves. When defining the EQOs there are several considerations that must be taken into account, e.g. the EQO should focus on the desired outcome, be clear and concise; be both ambitious and realistic; be measurable, and be compatible with each other.

Some examples of EQO topics may be:

- Sustainability of fish harvesting;
- Minimisation of bycatch;
- Maintenance of key wildlife populations and/or indicator species (e.g. cetaceans, seabirds, sardines);
- Acceptable seawater quality (can be differentiated according to zones – e.g. proximity to towns, MPAs, etc.);
- Maintaining (or enhancing) ecological integrity;
- Air quality;
- Ratio of development and conservation areas, including zonation;
- Capacity of local institutions (e.g. government agencies, service providers, employees, civil society, etc.) – especially to apply (and enforce) environmental safeguard tools. Could emphasise the need for partnerships in order to achieve required levels of inclusivity and competence;
- 'Wellness' and health targets (a basket of social parameters).

The EQOs and LACs should be agreed upon by key stakeholders early in the SEA process.

Step 6: SEA Report

Proposed draft Table of Contents

1. Executive Summary
2. SEA Team (who was responsible for what)
3. Acronyms
4. Glossary
5. Acknowledgements
6. Introduction to SEA
   Purpose of the SEA, what it aims to achieve, how the outcome can support SD in the BCLME
7. BCLME overview
   Brief (<10 pages) and well illustrated (maps, graphs, statistics) overview of history, key ecological functioning, land/resource-use, geography, socio-economy, demographics, biodiversity, mineral resources, physical infrastructure and climate.
8. Forces and dynamics of the BCLME
   Brief (<10 pages) and well illustrated (maps, graphs, statistics) overview of external and internal factors that shape current and especially future development options. Emphasise trends rather than just a snap-shot (e.g. resource use and effects over past 20 (or more) years.....)
9. Scenarios
   What is expected to happen over the next 10-15 years, especially in the context of key economic drivers – such as fishing, mining, shipping, industrialization, tourism, mariculture, urban development.
10. SEA Approach and Methodology
    Overview of SEA approach, assumptions, limitations and constraints
    SEA methodology for:
    - Stakeholder engagement, Thematic analyses, Use of GIS, Assessment of linkages and cumulative effects, construction of scenarios.
11. Legal, policy and institutional context (Overview)

12. Cumulative Effects of current and likely future development (and analysis of alternatives) on:
    - Livelihoods and access to resources, human health, gender issues, tenure and community wellness
    - Institutional functioning and governance
    - Biodiversity and ecological integrity
    - Archaeological heritage
13. Linkages, antagonisms and synergies within and between sectors
14. SEMP with EQOs and indicators
15. Best practice guidance:
    - Establishment and management of towns and settlements
    - Ports and industrial parks
    - Desalination of seawater
    - Shipping
    - Prospecting and mining
    - Prospecting for and development of, oil and gas resources
    - Fisheries
    - Mariculture
    - Coastal and marine recreation and tourism
    - Catchment management
    - Aquifer management
16. Conclusions
17. Recommendations
18. Appendices:
    - References
    - TORs
    - Stakeholders consulted, minutes of meetings, correspondence (input) received from stakeholders, Issues-response form
    - Copies of adverts, press cuttings, etc.

Step 7: Development of social and environmental framework for current and future policies, plans, programmes and projects

Based on the previous steps, the SEA should be able to advise on what could be done to make current and future developments more environmentally acceptable. From this, it is clear that the team required to conduct the SEA is much more than the usual consortium of environmentalists. One needs input from a range of specialists including: GIS, policy, spatial planning, coastal processes, oceanography, fisheries, mariculture, biodiversity, tourism, human health and wellness, archaeology, resource economics, pollution, mining, shipping and ports, and climate change. The core team needs to be experienced in conducting large-scale SEAs.

Once the assessment of cumulative impacts is done it will be possible to design a framework within which the individual and cumulative impacts relating to the development activities could be better managed. This framework could be regarded as a "Strategic Environmental Management Plan" - SEMP, which sets the actions that all the countries and developers could follow and contribute to.

The SEMP will rely on a variety of inputs for content and ideas, including the BCLME SEA. Ideally, the outcome of the semp is a series of more targeted guidance offered to planners, managers and developers of key sector drivers and target areas (Figure 3).

The sectors, development nodes and conservation hotspots depicted in Figure 3 are merely indicative – they will be identified during the SEA.

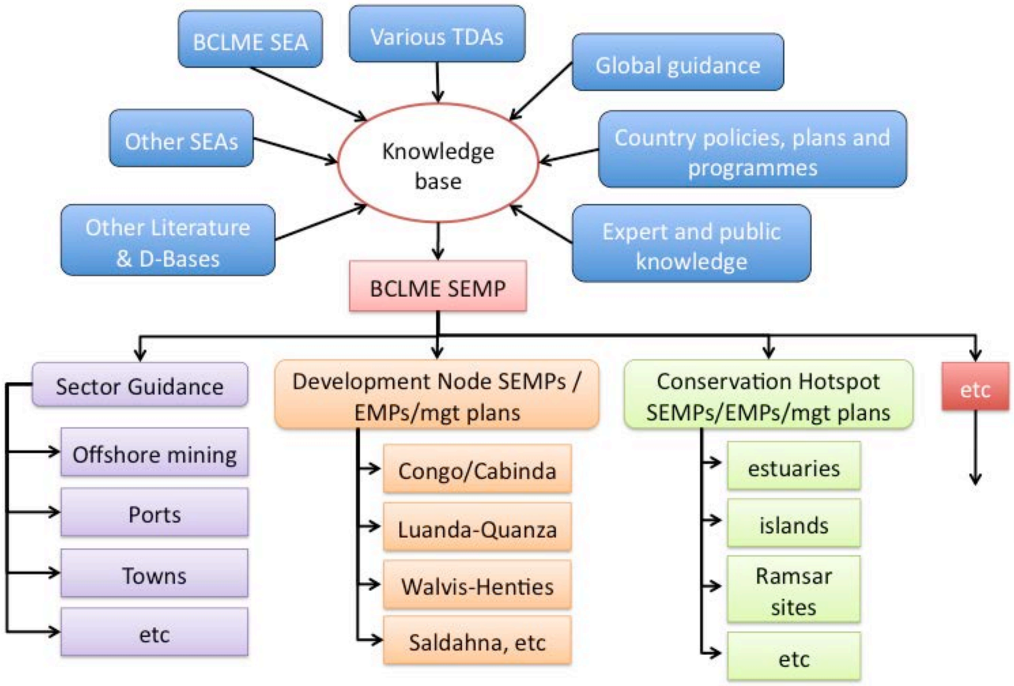

Figure 3: Illustration of SEMP inputs and possible spheres of influence

Step 8: Planning for individual projects

Existing and future projects need to be managed within the SEMP framework. The SEA needs to provide the fundamental baseline parameters to ensure that they are placed within a sound and sustainable management and development process. If the SEA is thorough enough, and if the SEMP provides sufficient detail, we should have a more efficient EIA process for individual projects/developments and a more outcome-oriented EMP for each case. Individual projects/developments will have different circumstances, so each case will be slightly different from the next.

It should be noted that many projects and resource-use practices are already operating (some for many decades), so the longer one waits, the less useful the SEA will be. Nevertheless, even established projects/developments will benefit from an understanding of the cumulative impacts and they will likely gain from being able to align themselves with the SEA.

Step 9: Identifying opportunities for strategic sharing and combining of ancillary infrastructure/services provision

Consideration of a number of individual projects/developments should be examined with regard to opportunities for a combined and aligned approach to (for example):

- Early warning systems (e.g. occurrence of HABs);
- Disaster avoidance/management (e.g. maritime accidents, oil spill clean-ups, oiled seabird rehabilitation);
- Research and monitoring (e.g. marine environment, resource use, mitigation measures, spread of alien invasive organisms);
- Waste management (including repositories, recycling facilities);

- Co-location of synergistic industries;
- Cleaner technology (e.g. water treatment, wastewater management, reducing bycatch);
- Tourism planning and management (e.g. 3-country Namib Desert/Coast packages);
- Etc.

Many of the above are already envisaged by the BCC.

The point being made here, is that many sectors could join forces and collaborate so that economies of scale can be achieved in matters relating to the above list. The alternative (which is inefficient and possibly counter-productive) is everyone "doing their own thing" with minimal collaboration.

Step 10: Monitoring, Evaluation and re-design

This is an ongoing activity, which may already be implemented by various projects/developments. The SEA should provide a framework for this, but one can say at the onset that a three-tier system is needed:

- The first is self-monitoring by each developer. This must be very detailed, and linked directly to the project-specific EMP. The developer must be able to judge for itself if it is in line with the EMP or if there's a problem emerging (e.g. excess water use, pollution). Every formal project that has an official permit will report to some government agency in either of the 3 countries, against both the requirements of its various permits and licences, and against environmental targets contained in its EMP. The project may also report to its own shareholders (if it is a listed company) and to the system put in place at whichever stock-exchange it might be listed.

- Second, the industry or agency (for example a Port Authority) must report collectively on a range of issues that are deemed to be cumulative impacts resulting from their combined activities. This combined report should reflect on the outcomes (environment quality objectives) identified in the SEA. It would be preferable if independent institutions (e.g. the BCC) are involved in the monitoring so that there is a degree of independence and thus credibility. It is equally important that individual and collective monitoring makes use of internationally accepted and consistent methodologies so that results are comparable and credible. Ideally, the data collection required for the project's own monitoring will be the same as that required for the combined report, so that one does not arrive at a situation where many different monitoring programmes are running in parallel.

- Thirdly, each project is free to apply to the International Standards Organisation for an appropriate ISO rating.

Thus, the combination of project-specific EMPs, sustainable policy-making, the SEA–linked monitoring programme, corporate and international reporting requirements should result in a very robust and transparent system.

6.3 Team composition and key tasks

Category	Key role	Time
1. Team Leader	▪ Overall leadership (steer process, manage and integrate specialists, review draft inputs, troubleshoot, negotiate access to data/resource persons/authorities, overall responsibility for process and product) ▪ Run cumulative impact assessment analysis workshops, draw linkage diagrams, report compilation ▪ Client liaison	▪ ?
2. Deputy Team Leader	▪ Assist team leader with management, analysis, report compilation	▪
3. Project manager	▪ assist Team Leader – track progress against contract, deliverables, timeline and budget ▪ obtain soft/hard copies of all pertinent literature, maintain meta database, compile ongoing bibliography and consultation records	▪
4. Stakeholder liaison	▪ develop and maintain stakeholder database – communicate with stakeholders	▪
5. Macroeconomist	▪ Specialist input on economics of the BCLME, including projections, cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
6. Resource economist	▪ Work closely with macro-economist, focusing mostly on use, non-use and existence values of natural resources, and opportunity costs. Including projections, cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
7. Environmental lawyer and institutional specialist	▪ Analyze key policies, laws and institutions ▪ Assess alignment (within and between sectors and countries), and between countries and global commitments and instruments	▪
8. Maritime transport, port and heavy industry specialist	▪ Analyse transport, port and heavy industry sectors (current situation, trends, projections, vulnerabilities, comparative advantages). Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
9. Oceanographer	▪ BCLME Oceanography overview and assessment of vulnerability to external and internal impacts. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
10. Coastal geomorphology specialist	▪ BCLME coastal geomorphology overview and assessment of vulnerability to external and internal impacts. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
11. Climate change specialist	▪ Overview and scenarios	▪

12. Estuary and wetland specialist	▪ BCLME estuary and wetland overview and assessment of vulnerability to external and internal impacts. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
13. Fisheries specialist	▪ Fisheries overview (past, present and future), assessment of vulnerability to external and internal impacts, assess sustainable development potential. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
14. Marine mammal specialist	▪ Marine mammal overview (past, present and future), assessment of vulnerability to external and internal impacts. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
15. Ornithologist	▪ Bird overview (past, present and future), assessment of vulnerability to external and internal impacts. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
16. Tourism specialist	▪ Tourism overview (past, present and future), assessment of vulnerability to external and internal impacts, assess sustainable development potential. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
17. Mariculture specialist	▪ Mariculture overview (past, present and future), assessment of vulnerability to external and internal impacts, assess sustainable development potential. Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
18. Mining specialist	▪ Analyse mining sector (current situation, trends, projections, vulnerabilities, comparative advantages). Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
19. Marine pollution specialist	▪ Analyse pollution situation (current situation, trends, projections, vulnerabilities). Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	▪
20. Social and health impact specialist	▪ Analyse social and health situation (current situation, trends, projections, vulnerabilities). Including understanding of cumulative impacts, synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation. Emphasise HIV and AIDS	▪
21. Archaeologist	▪ Archaeological overview (past, present and future), assessment of vulnerability to external and internal impacts. Including understanding of cumulative impacts,	▪

	synergies, antagonistic impacts, scenarios – assist with overall analysis, linkages and report compilation	
22. GIS	▪ Mapping and database management	▪

6.4 Time frame

To be discussed

6.5 Budget

To be discussed

Appendices

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Incomplete – to be added to

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B. Meeting attendance

LUDERITZ - 7/08/2012

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CAPE TOWN - 23/08/2012

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LUANDA
To follow

BENGUELA
To follow

CABINDA
To follow

C. Additional Climate Change information

D. List of Cities, Towns and Villages

Name	Population (date)
South Africa: Cities and larger towns	
Port Elizabeth	136,539 (2001)
Plettenberg Bay/Keurboomstrand	
Kynsna	65,051 (2001)
George	136,539 (2001)
Mossel Bay/Hartenbos	117,859 (2007)
Somerset West/Strand	107,052 (2001)
Cape Town (including Bloubergstrand and Melbossstrand)	3,500,000
Saldanha Bay	21,636 (2007)
South Africa: Small towns and villages	
Skoennakerskop	
Clarendon Marine/Kini Bay	
Sea View	
Paradise Beach/Ashton Bay/Jeffrey's Bay	
Cape St Francis/St Francis Bay	
Eersterivier	
Nature's Valley	
Noetzie	
Brenton-on-Sea	
Buffelsbaai	
Sedgefield	
Kleinkranz	
Wilderness	
Victoria Bay	
Herold's Bay	
Groot Brak River/Bothastrand/Glentana	
Klein Brak River/Tergniet	
Dana Bay	
Vleesbaai	
Gouritzmond	
Still Bay	
Jongensfontein	
Witsand	
Cape Infanta	
Arniston/Waenhuiskrans	
Struis Bay/Agulhas	
Pearly Beach	

De Kelders/Gansbaai/Van Dyks Bay/Franskraal	
Hermanus/Onrus	
Hawston	
Kleinmond	
Betty's Bay/Pringle Bay/Rooiels	
Gordon's Bay	
Yzerfontein	
Churchhaven	
Langebaan	
Jacobsbaai	
Paternoster	
Shelly Point	
Britannia Bay	
Stompneus Bay	
St Helena Bay	
Velddrif/Port Owen/Pelican Beach	
Dwarskersbos	
Elands Bay	
Lambert's Bay	
Doring Bay	
Strandfontein	
Papendorp	
Brand-se-Baai (Namakwa Sands)	
Groenriviersmond	
Hondeklip Bay	
Kleinsee (DBCM)	
Port Nolloth/McDougall Bay	
Alexander Bay	
Namibia: Cities and large towns	
Oranjemund (Namdeb)	
Lüderitz	
Walvis Bay	
Swakopmund	
Namibia: Small towns and villages	
Wolzkasbaken	
Henties Bay	
Angola: Cities and large towns	
Namibe	89,442 (2009)

Dombe Grande	18,208 (2009)
Baia Farta	13,761 (2009)
Benguela	131,281 (2009)
Catumbela	14,862 (2009)
Lobito	145,652 (2009)
Sumbe	50,458 (2009)
Luanda	2,583,981 (2009)
Angola: Small towns (<10,000) and villages	
Cambongue	3,638 (2009)
Saco/Giraul	5,988 (2009)
Baia das Pipas	
Magellan	
Santa Rosa/Venacio Guimaraes	
Bentiaba	
Santa Marta	
Santa Maria	
Cuio	
Quicombo	4847(2009)
Egito Praia	
Porto Amboim	8755 (2009)
Pacuária da Barra do Longo	
Caboledo	3966 (2009)
Calumba	
Palmeirinhas	
Belas	