Systematic Marine Biodiversity Plan for the West Coast of South Africa

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Systematic Marine Biodiversity Plan for the West Coast of South Africa

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Acronyms

NBA	National Biodiversity Assessment
OMPA	Offshore Marine Protected Area
SAN Parks	South African National Parks
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
NEBP	National Estuarine Biodiversity Plan
NPAES	National Protected Area Expansion Strategy
MPA	Marine Protected Area
SANBI	South African National Biodiversity
WWF	World Wildlife Fund
EEZ	Exclusive Economic Zone
DAFF	Department of Agriculture, Forestry and Fisheries

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1. Introduction:

The IUCN (2012) defines conservation as "the management of human use of the biosphere so that it may yield the greatest sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirations of future generations." Conservation therefore can be seen as an activity for the benefit of people, and is a positive concept that embraces protection, sustainable utilisation, restoration, and enhancement of the natural environment (Robinson 1989). However, most decision-makers view conservation as being in opposition with development and see it as an obstacle to economic growth as it restricts the use and alteration of natural resources and habitats respectively. Overexploitation and the irreversible transformation of habitats, and the resulting fallout caused by the collapse of ecological services enjoyed by humanity (such as the provision of food and livelihoods through fishing) have in recent years emphasised the need for a more sustainable approach to resource utilisation and land- and sea-use management and planning.

The Government of South Africa published a National Protected Area Expansion Strategy (NPAES) in 2010 which describes a protected area as "*areas of land or sea that are protected by law and managed mainly for biodiversity conservation."* Protected areas are one of the management tools available that can assist in protecting areas that have a high biodiversity conservation value and/or provide ecosystem services. The establishment of an inshore marine protected area (MPA) network in South Africa was initiated in 1964 with the establishment of Tsitsikamma National Park – the oldest MPA in Africa (MPA News). Since then South Africa has successfully proclaimed an additional 22 areas for marine protection, with the latest addition to this network, the Amathole MPA, being proclaimed in the Eastern Cape. Notably however, this network of MPAs that covers much of the diversity along the South African coastline has not expanded into the offshore environment, and at present there is no marine protection, neither inshore nor offshore, in the Northern Cape (as illustrated by the large areas of Zero Protection in this region - Figure 1).

The NPAES (Government of SA 2010) has identified that the focus for expansion in the marine environment should be offshore, as well as in the Namaqua bioregion. These priorities were re-iterated in the National Biodiversity Assessment 2011 (Sink *et al.* 2012). This region has historically provided much economic benefit to South Africa through the utilisation of mining and fishing resources, leading to economic interests superseding those of biodiversity conservation. Many previous attempts at proclaiming a protected area in the region have met with vociferous opposition from industry with a call for an improved science-based rationale for proclamation of MPAs.

In 2006, the Offshore Marine Protected Area Project (OMPA) was initiated to address the inshore bias in South Africa's MPA network to support ecosystem based management and spatial planning in the offshore environment and identify a potential network of offshore MPAs or other types of effective spatial management (Sink and Attwood 2008, Sink *et al.* 2011). A systematic planning approach was used in accordance with South Africa's approach to protected area planning (Government of South Africa 2010). Systematic biodiversity planning is explained in more detail in Section 3.1. Much of the science has focused on methods to identify areas where objectives can be achieved with minimum impact to industry (Pressey 1999, Ball and Possingham 2000, Possingham *et al.* 2000, Watts *et al.* 2009).

Systematic biodiversity plans have also been carried out at a regional scale in the KwaZulu-Natal province by Ezemvelo KZN Wildlife (Harris *et al.* 2011), and in the Agulhas bioregion (Clarke and Lombard 2007), and at a site scale in the proposed extension of the Addo National Park by South African National Parks (Oosthuizen *et al.* 2011). This plan is the first to be undertaken for the West Coast of South Africa and has the following aims:

- to protect representative examples of all marine and coastal habitat types found in the planning area,
- to contribute to the long term persistence of marine biodiversity and its underlying processes,
- to provide undisturbed areas for scientific study and long term monitoring,
- to protected threatened marine species and sensitive marine and coastal habitats
- and
- to promote appropriate non-consumptive use of the marine environment.

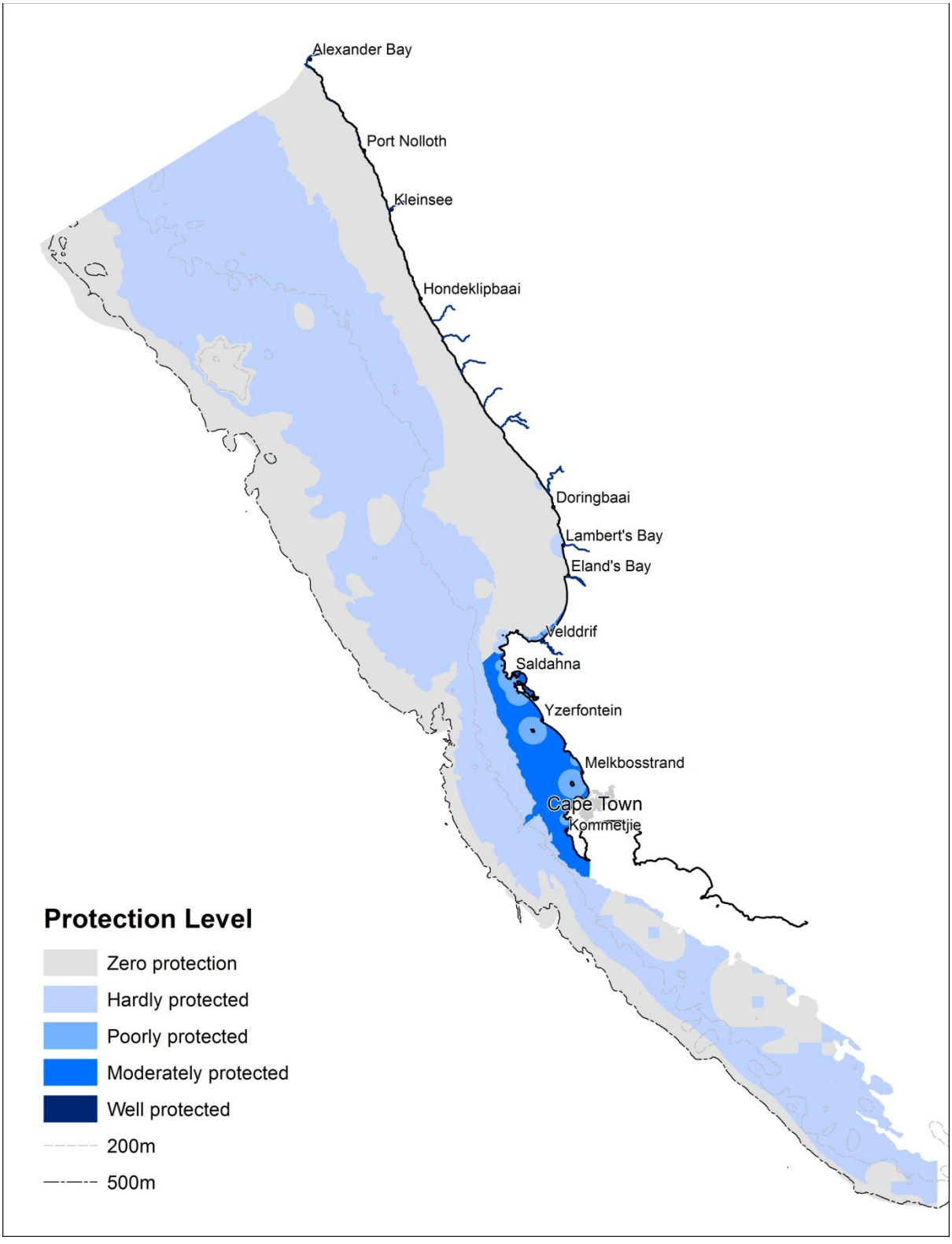

Figure 1: *Protection levels for habitat types found in the planning area.*

1.1 Planning area

The inshore portion of the planning area extends from the Orange Rive, on the border with Namibia in the Northern Cape, to the tip of Cape Point in the Western Cape. The extent of the planning area includes the entirety of the Namaqua Inshore, Namaqua Inner Shelf, Southern Benguela Outer Shelf, Southern Benguela Shelf Edge, Southwestern Cape Inshore, and Southwestern Cape Inner Shelf ecozones (Figure 2). Descriptions of how the habitat types within these ecozones (Figure 4) were mapped are described in the Marine and Coastal Component of the National Biodiversity Assessment 2011 (Sink *et al*. 2012) – see Box 1.

Box 1: *Excerpt from the NBA 2011 (Sink et al. 2012) on the mapping of benthic habitats.*

Inshore and offshore benthic habitat mapping

Inshore and offshore benthic habitat types were mapped using existing data sets for wave exposure, geological features and grain size. For unconsolidated sediments in the inshore and offshore, the texture map (Marine Geoscience 1986) that was digitised during the 2004 assessment was used and some of the sediment types merged to result in a less complex result. The following texture types were grouped in accordance with the classification by Connor *et al.* 2006;

- Sand and muddy sand were classed as sand
- Mud and sandy mud were classed as mud
- Gravelly mud and mud sand gravel were classed as mixed
- Gravel and sandy gravel were classed as gravel

The texture map does not extend beyond the shelf edge for most of South Africa and the digitised geological map (Dingle *et al.* 1987, Lombard *et al.* 2004) was used to support the mapping of deepsea sediments.

Reef data were acquired from SANBI's Reef Atlas Project (Majiedt and Sink 2011), a dedicated project that aims to address a research priority that emerged from the 2004 assessment (Lombard *et al.* 2004, Driver *et al.* 2005) i.e. the classification and mapping of reefs. The GIS layers for hard grounds, seamounts, submarine banks (Child's Bank) and submarine canyons as developed by SANBI's Offshore MPA project team (Sink *et al.* 2011) were used for these distinct habitat types. Hard grounds were developed from DAFF's untrawlable grounds database that shows which 5 minute survey grids are considered untrawlable due to the presence of reef, other types of hard substrate or areas of strong current. These areas are demarcated as places where research trawling should not take place due to the high risk of gear damage and loss, and unsuccessful sampling during demersal research trawl surveys. Areas of strong currents were removed from this GIS layer with only the known areas of hard ground included (Rob Leslie, pers. comm.).

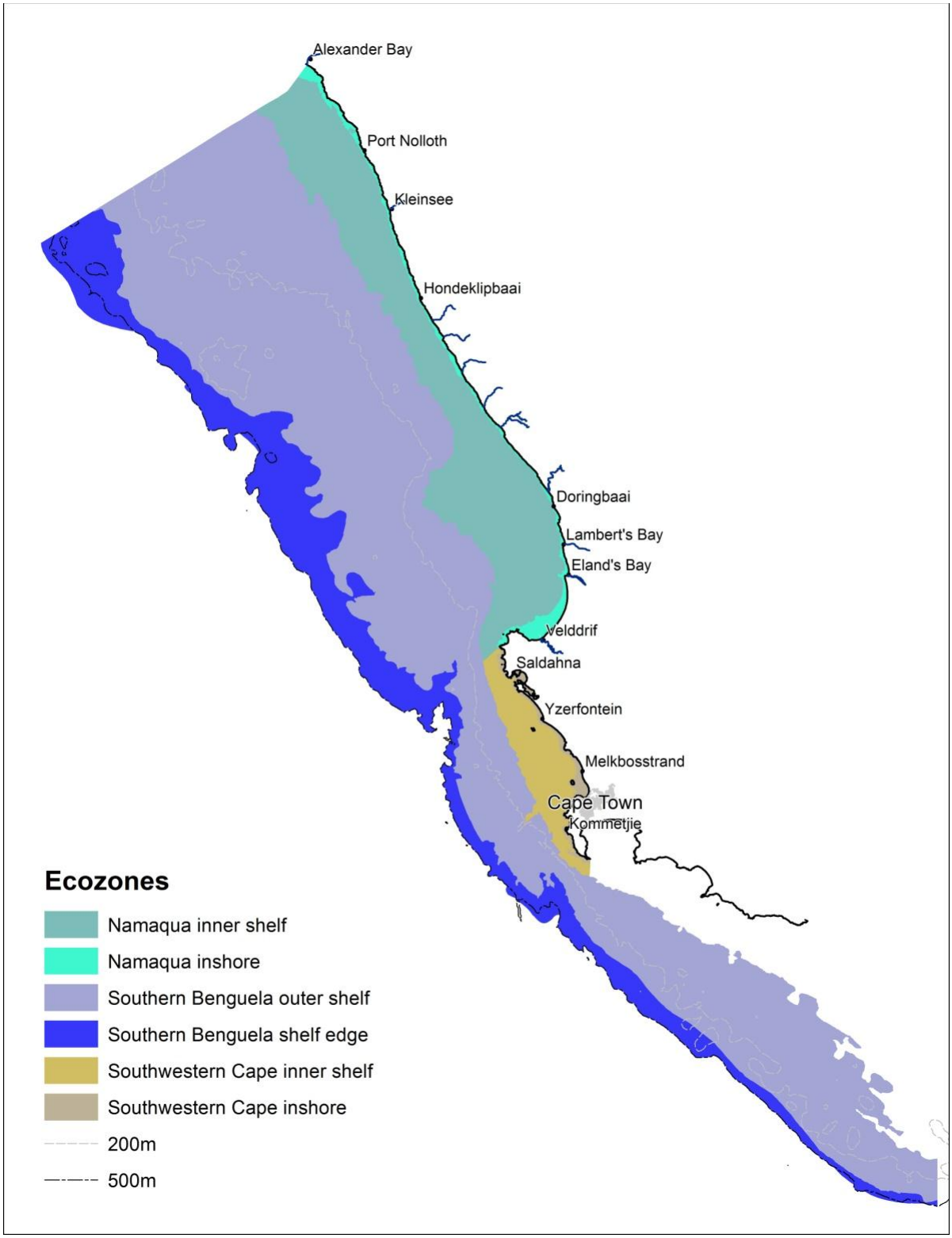

Figure 2: *Map of the Benthic Ecozones within the planning area.*

2 Background

The need for protection in the Namaqualand region was initially identified in 1977 by a Marine Reserve Committee (*Komitee Insake Reservate*) which was established in the previous year to investigate and recommend guidelines for the establishment of MPAs (Marine Reserves Task Group 1997). This committee recommended 15 areas for proclamation, identifying the area between the Groen and the Spoeg River along the Namaqualand coast line as the priority area in the Northern Cape. These recommendations led to the proclamation of many of the reserves we have in existence today, but there was no progress in Namaqualand once the committee was disbanded in 1978.

In 1984, an ad hoc committee was established and interest was re-ignited for an MPA in the Namaqualand region, but this group was limited in its ability to maintain momentum resulting in earlier efforts made to address the problems with MPA management and marine protection having no lasting effect (Marine Reserves Task Group 1997). In 2004 however, the National Spatial Biodiversity Assessment (Lombard *et al.* 2004) was undertaken to assess the state of biodiversity and once again the need for protection in the Namaqualand region was identified. The proposed Namaqualand MPA (Figure 3) was proposed under Section 43 of the Marine Living Resources Act, and a Notice of Intention to Declare was published in the Government Gazette for public comment, where the objectives of the area were to:

(1) Protect marine habitats and ecosystems that are representative of South Africa's cool-temperate west coast;
(2) Serve as a reference area against which the effects of demersal trawling can be assessed; and
(3) Promote ecotourism along a coastline that has been elsewhere heavily impacted by diamond mining.

An unpublished report by Sink (2008) summarised the key obstacles and opportunities for proclaiming offshore MPAs. These included the concerns raised by the Department of Mineral Resources:

- Existing offshore diamond mining rights within the proposed NMPA (8a, 8b, 9a – Namagroen, 9b Pesa Properties, 9c De Beers and 9d –Alexcor)
- Existing petroleum rights – Offshore Block No.2 - Forest International
- Concern over the 180 km westward seaward extent. They note that the proposed MPA cuts a swathe across the area presently under evaluation for the Ibhubesi Gas fields and fairways and recommend that "changes be made to the demarcation of the proposed protected area in order not to negatively influence the proposed gas development within this area".

Several letters of objection and legal opinions were received from industry stakeholders. A common objection was the lack of stakeholder consultation. In addition, within the diamond mining sector, one concession holder (NamaGroen) would have to absorb most of the impact of the MPA with 90% of the license area falling within the proposed MPA. The then Department of Minerals and Energy also objected to this MPA in light of important mining and petroleum resources and a failure to consult with this department during planning.

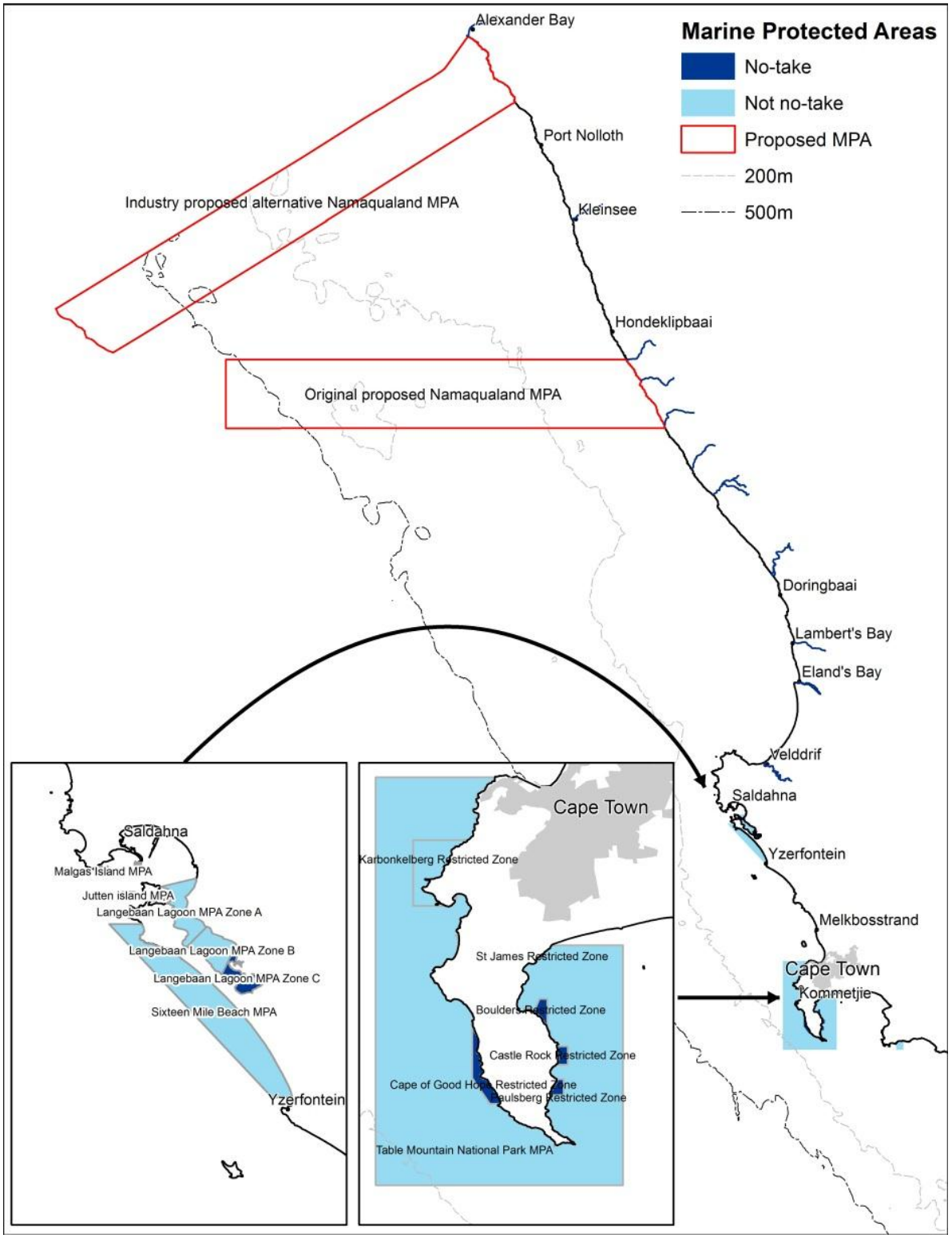

Figure 3: *Existing and proposed MPAs. Existing - Table Mountain, Langebaan, Sixteen Mile, Marcus and Jutten Island. Proposed - The original proposed Namaqualand MPA as specified in the government gazette in 2004, and the industry suggested MPA along the Namibian border.*

The letter of objection from the South African Deepsea Trawl Industry Association to the then Marine and Coastal Management (April 2004) highlighted the following;

- No consultation with the fishing industry had taken place. SADSTIA considered early consultation essential.
- The proposed MPA impinged upon long established trawling area.
- No explicit scientific justification was made out and industry was unaware of any scientific cause for selecting the area in question.
- The loss of trawling ground was more extensive than it appeared because it would interrupt set trawling lanes and processing would have to take place outside of the MPA.
- No data collection had been undertaken in the area to serve as baseline data to test the benefit of closing the area.
- The proposed MPA included a prime area for long-fin tuna that is traditionally relied upon by tuna line fishery.
- The proposed MPA impinged upon the iBubhesi gas field.

This Association recommended an MPA along the Namibian border with suggested co-ordinates included in their letter of objection (Figure 3).

3 Planning methods and inputs:

3.1 Planning Methodology

Links to Offshore Marine Protected Area Project and the National Biodiversity Assessment 2011 Marine and Coastal Component

The Systematic Biodiversity Plan for the West Coast of South Africa builds on work done for the Offshore Marine Protected Area Project (OMPA) (Sink *et al*. 2011) and the National Biodiversity Assessment (NBA) 2011 Marine and Coastal Component (Sink *et al*. 2012). The current project has no new data collation or generation component, but rather aims to utilise the data contained in these projects. It differs from these assessments in the following important ways:

- Unlike the previous spatial prioritisation undertaken for OMPA, the current assessment utilises the integrated classification and mapping of coastal and marine habitats derived as part of the NBA. This classification and mapping produced seamless benthic and coastal habitat maps which extend from 500m inland of the high-water mark to the EEZ, and pelagic habitat maps which extend from areas with a depth of 30m to the EEZ.
- Unlike the previous spatial prioritisation undertaken for OMPA, the study includes detailed coastal habitat mapping and habitat classification undertaken by the National Beach Classification and Mapping project (Harris *et al.* 2010), which was extended to rocky shores for the NBA. As the Systematic Biodiversity Plan for the West Coast of South Africa has a coastal and inshore focus, this is a key advance which could potentially significantly influence areas prioritised in the OMPA study.
- Unlike the previous spatial prioritisation undertaken for OMPA, the study utilises the maps of ecosystem condition derived for the NBA. Maps of current pressures on marine and coastal systems were used in the NBA to divide ecosystems into areas of “good”, “fair” and “poor” condition.

- Unlike the ecosystem threat status and protection level assessments undertaken for the NBA, the current assessment is undertaking a spatial prioritisation of areas for Marine Protected Area Expansion. The NBA assessed the ecosystem threat status and protection level for entire habitat types and was not aimed at identifying which specific areas were important for MPA expansion.

In addition to the major differences outlined above, the current study differs from the preceding OMPA and NBA Marine and Coastal Component Assessments in the following more subtle ways:

- The study builds in the estuary prioritisation undertaken for the National Estuary Biodiversity Plan for South Africa (Turpie *et al* 2012) and the NBA Estuary Component (Van Niekerk and Turpie 2012).
- The study includes some additional datasets which were not available when OMPA and the NBA were undertaken, in particular new data on reefs.
- The study utilises the interim target setting approach recommended in the review of approaches and targets for marine habitats undertaken by the South African National Biodiversity Institute (Porter *et al*. 2011).
- The study does not include the fisheries sustainability layers used in OMPA (e.g. hake spawning, large fish, and squid nests), and does not examine industry by-catch issues. Hence, this plan is purely looking at priority areas for protection of habitats and threatened species.
- The study utilises a different combination and weighting of marine pressure layers in deriving its cost surface (detailed later in Section 3.2.5) to those used in OMPA or in assessing marine habitat condition in the NBA.
- The study focussed on the Namaqua, South Western Cape and Benguela coastal and inshore areas with some information on the shelf. The OMPA results take precedent over these results in the offshore (>30 m depth) environment.

Biodiversity planning approach and broad methodology

As previously explained, the study followed the systematic planning approach which allows for the integrated consideration of multiple data sets in a transparent process to identify priority areas for spatial biodiversity management (Margules and Pressey 2000). The aim is to identify potential areas that meet a pre-defined set of biodiversity objectives (expressed as quantitative targets) while maximising efficiency which is often defined in terms of minimising economic cost or the area required to meet these targets. The approach is based on three key principles:

- The need to conserve a representative sample of biodiversity pattern (the principle of representation);
- The need to conserve the ecological and evolutionary processes that allow biodiversity to persist over time (the principle of persistence);
- The need to set quantitative biodiversity targets that tell us how much of each biodiversity feature should be kept in a natural condition in order to maintain functioning landscapes and seascapes (the principle of adequacy).

3.2 Data inputs

Systematic conservation planning for reserve expansion requires data on biodiversity features (which can be related to habitats, species or ecological processes), the condition of these biodiversity features, the current reserve network, as well as the cost of including any additional areas into the reserve network. These inputs are explained in the following sections.

3.2.1 Biodiversity features:

The primary biodiversity data used in this study were the integrated benthic and coastal, and pelagic habitat types, classified and mapped for the NBA. Figure 4 shows the 22 benthic and coastal habitat types used, and Figure 5 shows the four pelagic types used. In order to strongly favour the selection of good condition areas, as well as to a lesser extent fair condition areas (see Figure 8) of each habitat type, three different versions of the habit map were developed, namely a version which includes only the good condition areas of each habitat type, a version with good and fair condition areas, and then a version with good, fair and poor condition areas. The treatment of these different versions is explained in Section 3.4.

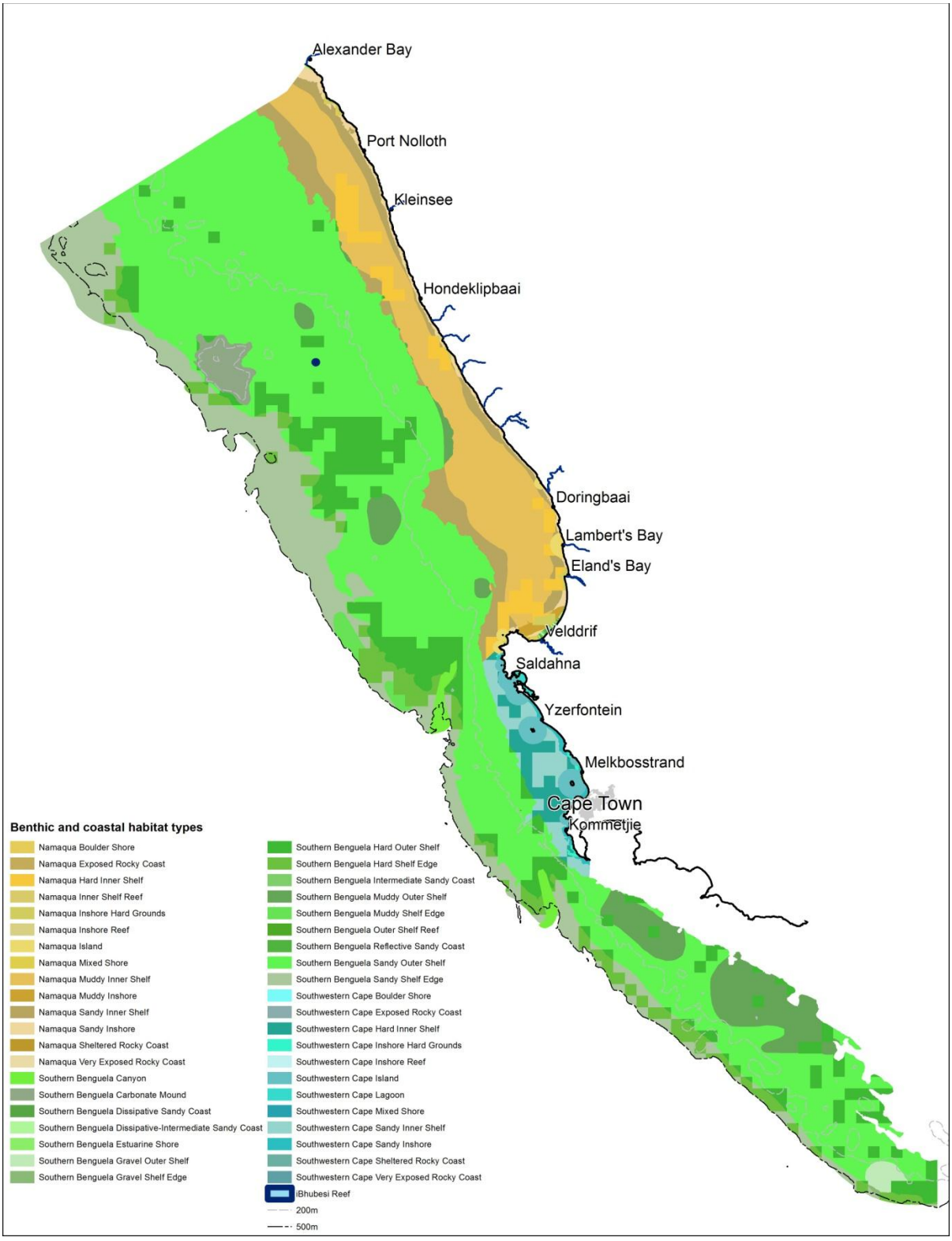

Figure 4: *Benthic and coastal habitat types used in this assessment. In addition, the iBhubesi Reef is indicated.*

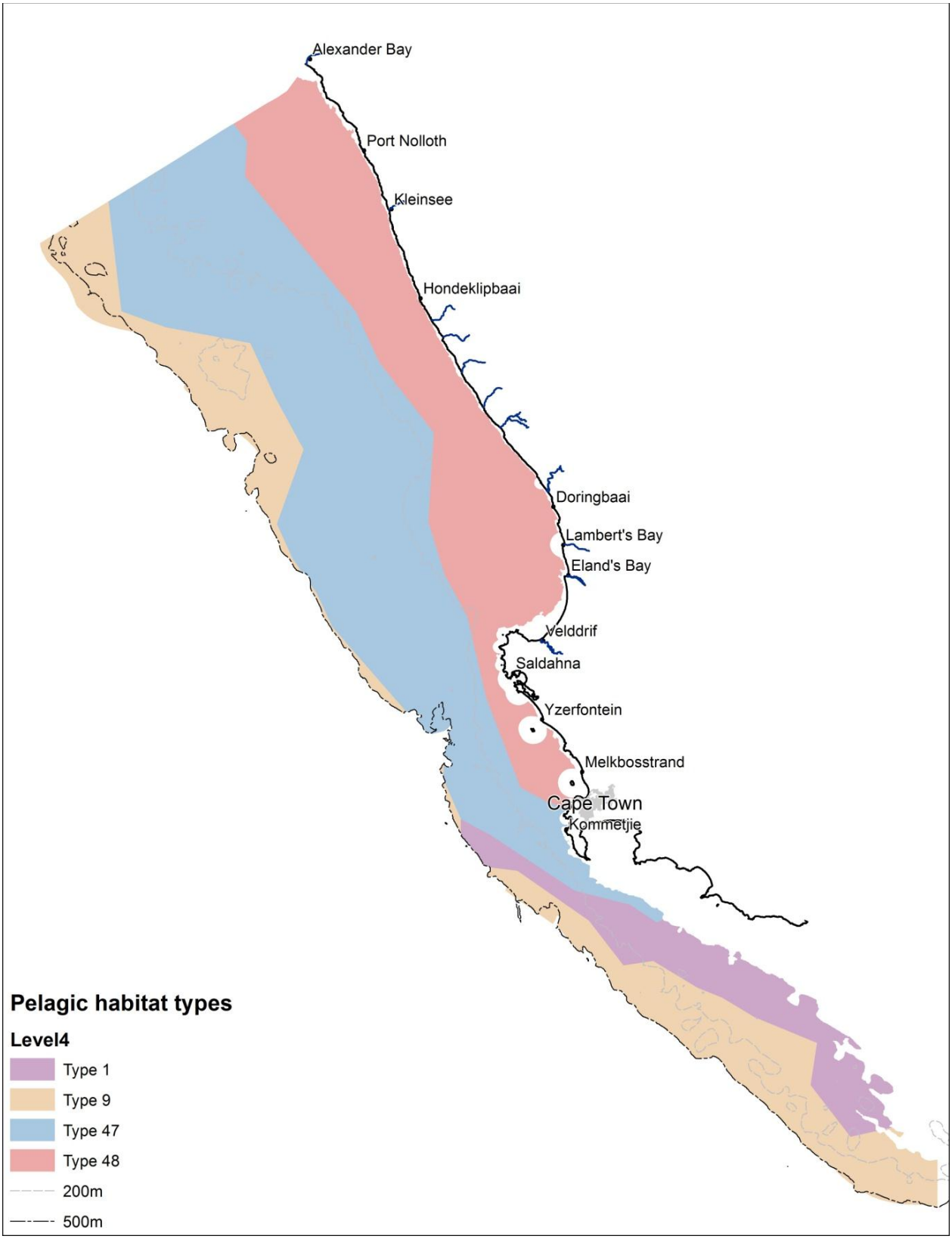

***Figure 5**: Pelagic habitat types used in this assessment.*

The NEBP for South Africa (Turpie *et al.* 2012) has just been released. The priority estuaries from this study were utilised rather than the underlying estuary types, firstly as it was more desirable to ensure alignment between the areas selected in the current prioritisation and those selected in the NEBP, and secondly because there is still some uncertainty around the estuary classification system and the habitat types used. Estuaries were divided into fully

selected estuaries, partially selected estuaries and other estuaries based on the outputs from the national assessment. Each of these three categories was used as a separate biodiversity feature (Figure 6).

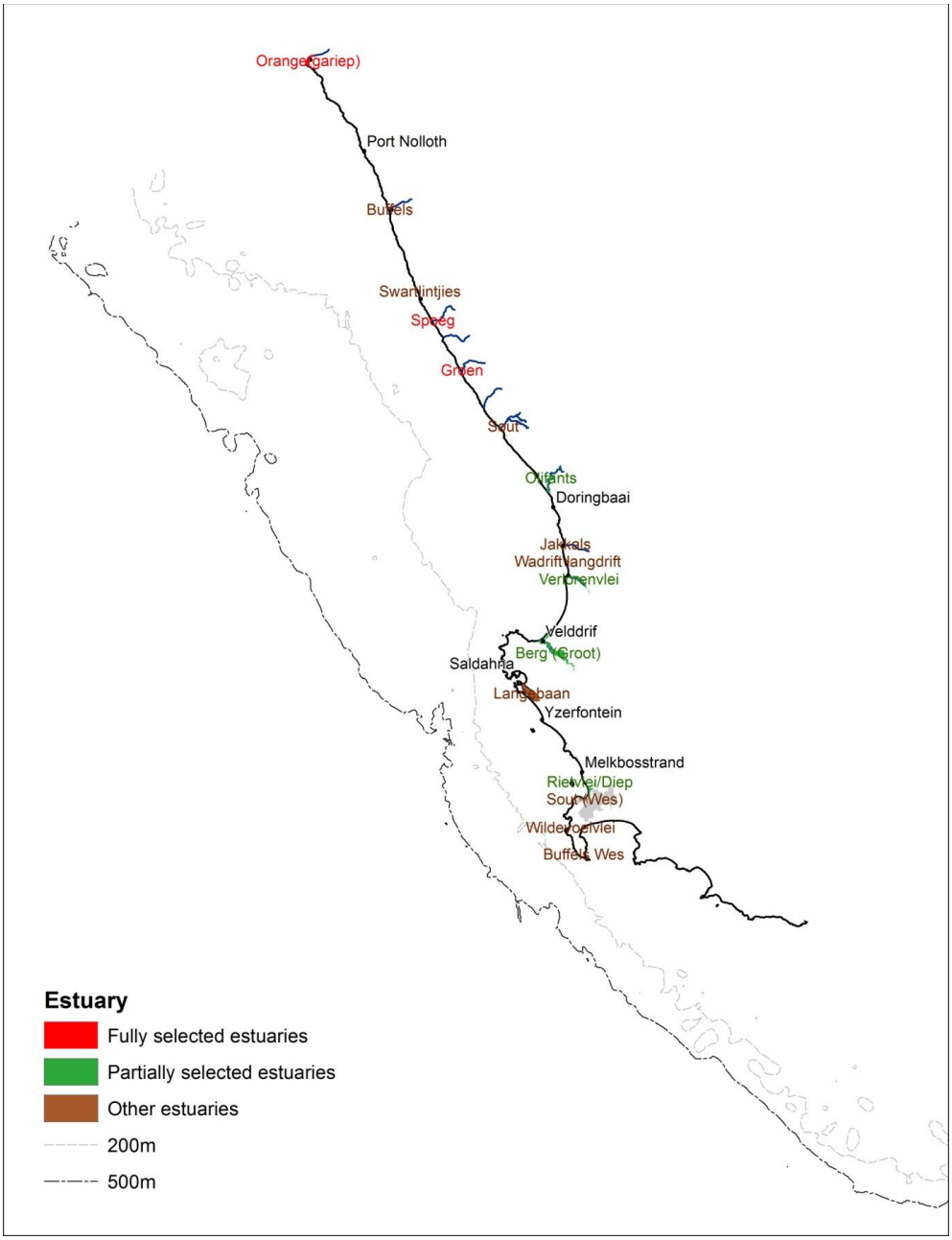

Figure 6: *Estuaries data used in this assessment based on the National Estuary Biodiversity Plan for South Africa (Turpie et al. 2012).*

A number of additional biodiversity features were included in the conservation assessment. These were:

- Data on vulnerable marine habitats (VMEs) – including cold water reefs, cold water corals, canyons, and carbonate mounds. Where a vulnerable marine habitat was already included as a habitat type (e.g. carbonate mounds and hard grounds) these were not duplicated. However, where key small scale vulnerable marine habitats such as cold water corals and cold-water coral reefs had not previously been included (e.g. the iBhubesi Cold Water Coral Reef), these were added.
- Additional reef data which were not available when OMPA and the NBA were undertaken were included.
- Species data for key threatened species were included (Figure 7). These were the areas identified in the OMPA project as being important for Bank Cormorants, Cape Cormorants, Gannets, African Penguins and linefish.

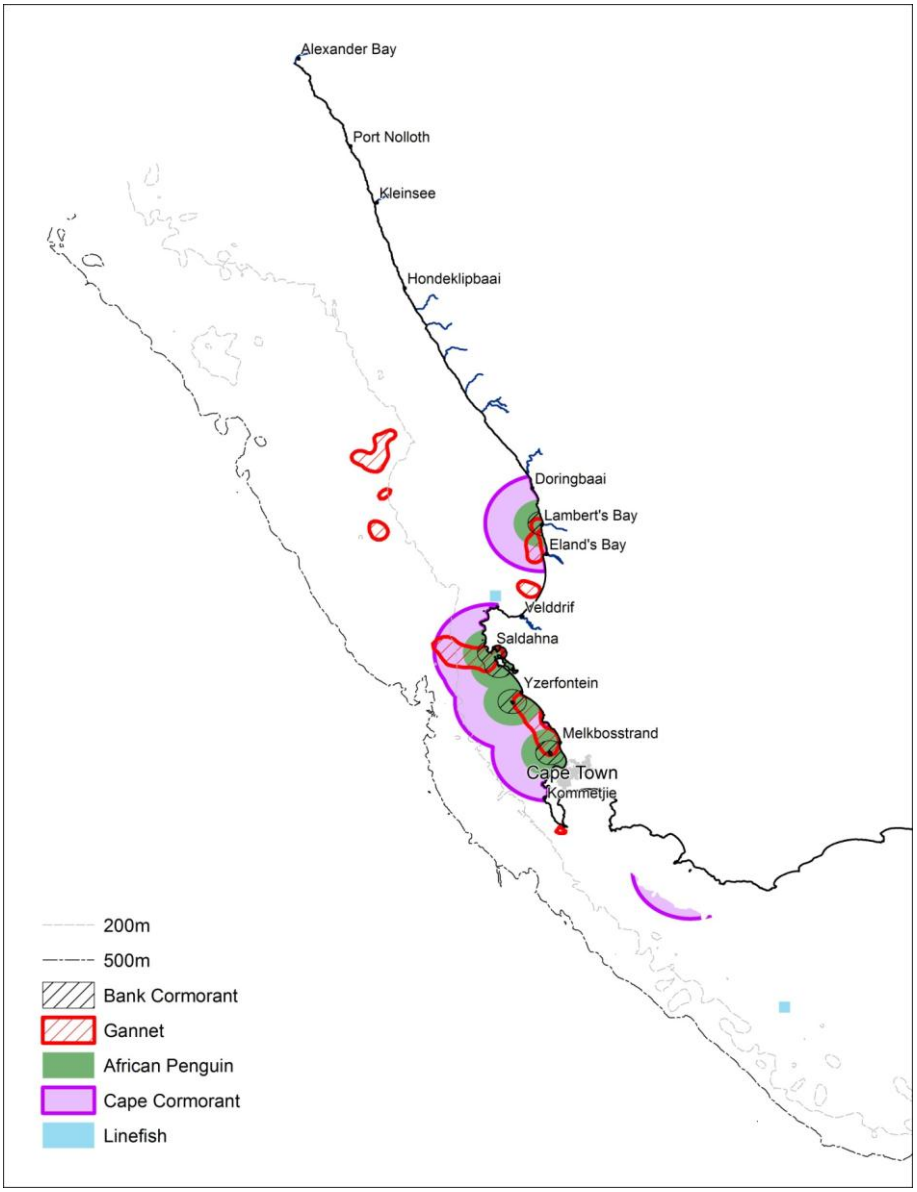

***Figure 7**: Species data included in the assessment.*

3.2.2 Habitat Condition

The study utilised the benthic and coastal habitat condition map developed for the habitat condition map used in the NBA 2011 (Figure 8). The NBA mapped the intensity of 27 pressures on marine and coastal ecosystems, including 18 types of extractive marine living resource use (13 commercial fisheries, commercial kelp harvesting, two types of recreational fishing, subsistence harvesting and shark nets), petroleum activities, diamond and titanium mining, shipping, coastal development, disturbance associated with coastal access, waste water discharge, mariculture, invasive alien species and the reduction of freshwater flow into marine ecosystems. As different marine and coastal habitats respond differently to the same pressure, the NBA used a pressure-impact matrix to score the impact of each pressure on each marine or coastal habitat type. This matrix was then used to develop a map of ecological condition (good, fair or poor) at the site scale, using a 5' grid (roughly 8 km by 8 km).

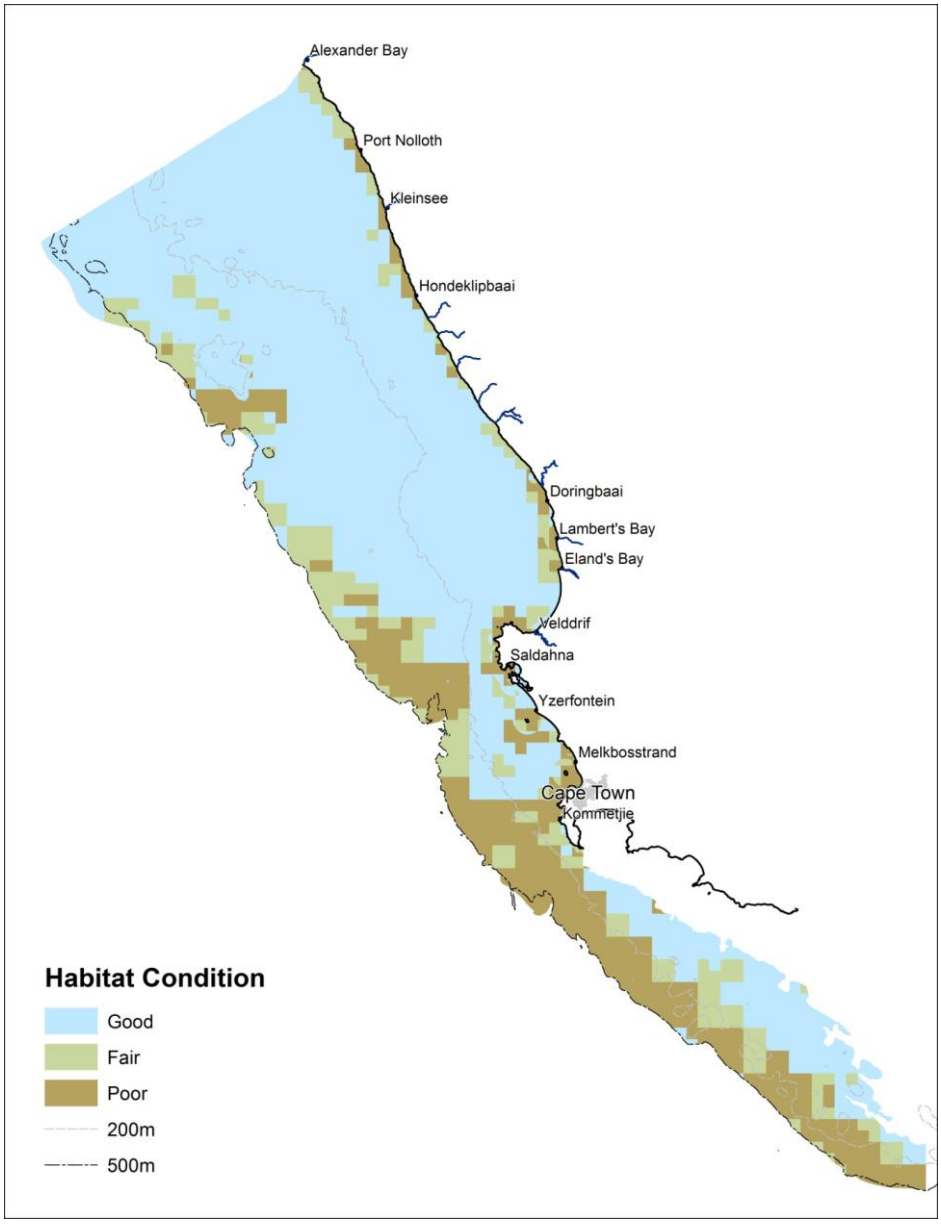

***Figure 8**: Habitat condition in the planning domain.*

3.2.3 Protected Areas:

The project used the most recent version of the SANBI MPA layer, which includes all proclaimed Marine Protected Areas (as at September 2012). Proposed protected areas were not used in the analysis. In addition, data on coastal terrestrial formal protected areas were obtained from a revised version of the NPAES dataset (Government of South Africa 2010) produced by SANParks. Although these are not Marine Protected Areas, they provide direct protection to the terrestrial portions of coastal habitat types, and may provide some indirect protection to adjacent marine portions of coastal habitat types even when these are not directly included in the protected area (e.g. by better controlling land based impacts on marine systems). Only the direct protection of the terrestrial portions of coastal habitat types is considered in the analysis. The summary of current protection given in Table 3 in Section 3, although this table summarises protection into the categories “No-take”, “Take” and “Terrestrial protection only”, there is no distinction made between different types of protection in the analysis.

3.2.4 Planning units

The project used 5' grids (approximately 8 x 8 km) for the spatial prioritisation. This scale represented a compromise between the finer-scale data available for some coastal habitat types and pressures and the coarser-scale offshore fishing data; and corresponded with the data collation scale of the major base data sources for this assessment (OMPA and NBA). This also facilitates direct comparison with the results of the OMPA project, and allows the two prioritization exercises to be combined if necessary.

The basic gridded planning units were clipped to the extent of the benthic and coastal habitat types (i.e. they did not extend inland of 500m from the coast or outside of the planning domain). Current protected areas (Section 3.2.3) were separately embedded into the planning unit grid in order to facilitate the Marxan analysis.

3.2.5 Cost surface

A cost surface summarising the cost of inclusion of additional areas into the protected area network was developed based on the marine pressure layers derived for the NBA. The NBA assessment produced 27 GIS layers reflecting the relative intensity of 27 drivers of ecosystem change (Table 1), not all of which are relevant or useful for fine-scale planning for the West Coast. These 27 pressures include 18 types of extractive marine living resource use (13 commercial fisheries, commercial kelp harvesting, 2 types of recreational fishing, subsistence harvesting and the shark control program), petroleum activities, diamond and titanium mining, shipping, coastal development and disturbance associated with coastal access, waste-water discharge, mariculture, invasive alien species and the reduction of freshwater flow into marine ecosystems. The current assessment excluded the alien invasive layer (as the data is not of sufficient resolution or complete enough to use for fine-scale planning on the West Coast), and the freshwater flow reduction data (for similar reasons). In addition, a number of industries (e.g. crustacean trawl, mid-water trawl and the South Coast Rock lobster industry) and impacts (e.g. the shark control programme) do not extend into the planning domain.

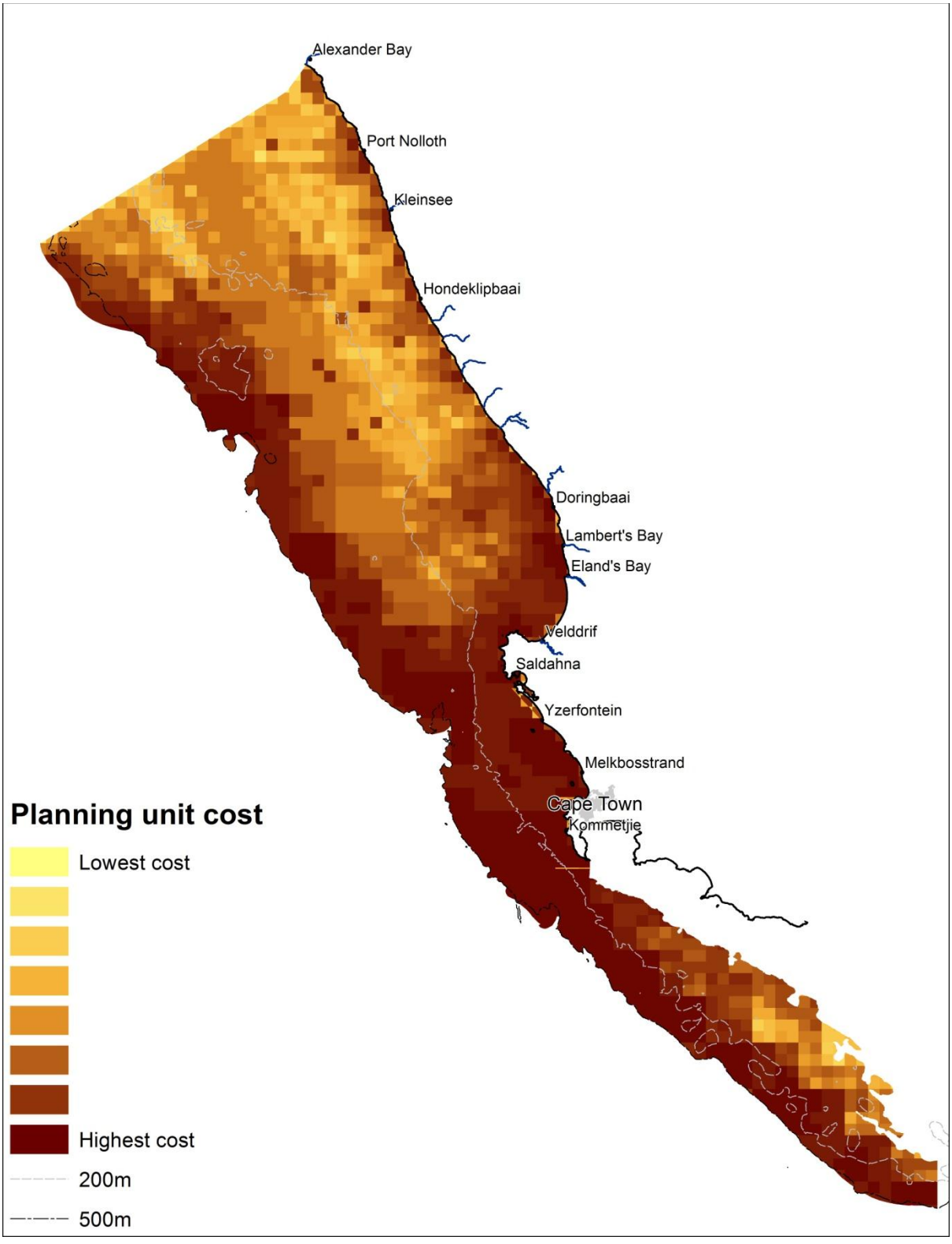

Figure 9: *Planning unit cost used in the analysis.*

The final cost surface was produced using the following formula:

- Total cost = Area + Costper* Area*1000
  - Where “Costper” = Equal weighted sum of the individual pressure layers for a planning unit.
  - Where “Area” is the area of the planning unit in hectares.

This cost surface is shown in Figure 9, where highest cost values occur along the coast and shelf edge due to the concentration of multiple pressures in these areas (Sink *et al.* 2012). Key pressures that underlie these patterns include the demersal trawl and longlining fishery, small and large pelagic fisheries, tuna pole fishing, diamond mining, petroleum exploration and production. Other contributing pressures include the west coast rock lobster fishery, mariculture, coastal development and waste water discharge. Detailed maps reflecting these pressures are available in Sink *et al.* 2012. Note that mined areas and petroleum wellheads were included in this cost layer rather than whole lease areas, as it was more important to avoid mined and drilled areas than entire leases as well as owing to the dynamic nature of these leases. There are also significant challenges in acquiring current information on existing rights holders lease expiry dates. However, some information on rights holders was acquired from the Department of Mineral Resources (DMR) and these have been used to identify key implementation considerations (see Section 5).

New prospecting leases that were not considered in the NBA 2011 that are relevant to this plan include prospecting rights for gold, sapphire, heavy minerals and platinum group metals (PGMs). PGMs are rare precious metals, which frequently occur together in nature as constituents of various ores and minerals. PGMs are a family of six metals: platinum, palladium, rhodium, iridium, ruthenium, and osmium. PGMs are regarded as strategic industrial metals because of their extensive use in the petrochemical, automotive and electronic industries.

Table 1: Available data layers on pressures, NBA 2011.

Pressures	Inclusion into West Coast Conservation plan
Alien Invasive Species	Excluded from cost surface as data resolution insufficient for planning purposes on West Coast.
Coastal development	Included.
Coastal Disturbance	Included.
Crustacean trawl	Does not extend into planning domain.
Demersal longline	Included.
Freshwater flow reduction	Excluded based on expert inputs.
Inshore demersal trawl	Does not extend into planning domain.
Kelp harvesting	Included.
Large pelagic fishery	Included.
Linefishing	Included.
Mariculture	Included.
Midwater trawl	Does not extend into planning domain.
Mining (see also petroleum activities)	Included.
Offshore demersal trawl	Included.
Petroleum activities	Included.
Recreational Boat Fishing	Included.
Recreational shore fishing	Included.
Shark control program	Does not extend into planning domain.
Shark fisheries	Included.
Shipping	Included.
Small pelagics	Included.
South coast rock lobster trap fishery	Does not extend into planning domain.
Squid fishery	Included.
Subsistence harvesting	Included.
Tuna pole fishery	Included.
Waste water discharge	Included.
West coast rock lobster fishery	Included.

3.3 Targets:

Setting quantitative targets for biodiversity features is central to the systematic conservation planning methodology. The study utilized the interim target setting approach for habitats recommended in the review of approaches and targets for marine habitats undertaken by the South African National Biodiversity Institute (Porter *et al.* 2011). The habitat targets are the same as those used in the National Biodiversity Assessment. Targets are summarized in Table 2. In addition, a number of supplementary targets were used in the design phase of the conservation assessment.

Table 2: Targets for biodiversity features used in this plan

Targeted Feature	Target	Comments
Primary biodiversity features		
NBA Benthic and Coastal Habitats (full extent)	20%	Target aligned with Porter *et al.* (2011) and the NBA.
NBA Pelagic Habitats (full extent)	20%	Target aligned with Porter *et al.* (2011) and the NBA.
Estuaries (National Estuary Biodiversity Plan)	100% 30% 20%	- Fully selected estuaries, - Partially selected estuaries - Other estuaries. Categories based on the outputs of the National Estuary Biodiversity Plan.
Potential vulnerable marine habitats - Carbonate mounds - Seamounts - Canyons - Cold water corals - Cold water reefs	20% of each feature type	Default habitat target aligned with Porter *et al.* (2011). Note that for OMPA a range of targets were used e.g.: Canyons – 20%, reef building cold water corals – 50%, iBhubesi reef – 30%.
Threatened species - Turtles - Bank Cormorants - Cape Cormorants - Gannets - African Penguins - Linefish	30% of each feature type	Note that for OMPA a range of targets were used i.e. 10%, 20% and 30%, with 30% used in integrated analysis. The target used here aligns with the integrated OMPA analysis.
Secondary planning targets		
NBA Benthic and Coastal Habitats (good and fair condition areas)	20% of full extent of habitat type	Additional target used to favour selection of good and fair condition areas before poor condition areas.
NBA Benthic and Coastal Habitats (good condition areas)	20% of full extent of habitat type	Additional target used to strongly favour selection of good condition areas before other areas.
Heavily under-protected benthic and coastal habitats in close proximity to protected areas	20%	A "dummy" biodiversity feature was created utilizing all unprotected, poorly protected and hardly protected benthic and coastal habitat types within 10km of existing protected areas. This was used to ensure that where heavily under-protected habitats were present in close proximity to existing protected areas, that these would be favoured for selection to meet the primary planning targets.

3.4 Planning software and overview of technical methods

The Marxan decision support tool developed by Ian Ball and Hugh Possingham was utilised, which is the most widely adopted site selection tool used by conservation groups globally, having been applied to local and regional planning efforts in over 60 countries around the world (Ball *et al.* 2009). The Marxan decision support tool is designed to provide an objective approach to site prioritisation which is adaptable and repeatable based on a function that evaluates very large numbers of possible alternatives and retains the most efficient solutions given a specific set of criteria. It is a stand-alone software program that provides decision support to conservation planners identifying efficient areas that combine to satisfy ecological, social and economic objectives. It utilises data on species, habitats, ecosystems and other biodiversity features; combined with data on planning unit cost; to identify sets of sites which meet all biodiversity representation goals while minimising the total cost of the solution and ensuring a spatially optimal configuration of sites.

The planning process implemented a number of design principles or rules during the spatial prioritisation:

- The plan intended to reduce costs to all industries by avoiding the places most important for each industry or activity. A cost surface approach was used to avoid all industries equally strongly.
- The plan aimed to meet all targets as far as possible but did not force the selection of poor condition areas. This balance was obtained by an iterative calibration of the Marxan input variables.
- Good condition areas were strongly favoured before fair condition areas, with good and fair areas favoured before poor condition areas. This was undertaken both by using the cost surface and by utilising "dummy features", where in addition to having the full extent of a habitat type as a feature, two versions of the habitat map clipped to the remaining good condition areas and the remaining good and fair condition areas were also utilised. The consequence of this approach is that targets are always first met in good condition areas, then in fair areas and, if absolutely required, in poor condition areas.
- The outputs were aligned with the estuary prioritisation undertaken for the National Estuary Biodiversity Plan for South Africa (Turpie *et al.* 2012) and the NBA Estuary Component (Van Niekerk and Turpie 2012). This was done by setting targets for the prioritised estuaries in this plan.
- The inclusion of very under-protected types in close proximity to existing MPAs and other protected areas was prioritised[1]. A “dummy” biodiversity feature was created utilising all unprotected, poorly protected and hardly protected benthic and coastal habitat types within 10km of existing protected areas. This was used to ensure that where heavily under-protected habitats were present in close proximity to existing protected areas, that these would be favoured for selection to meet the primary planning targets.
- An attempt was made to identify contiguous blocks of high priority areas rather than a scatter of priority sites. Firstly, this was done through careful calibration of the

[1] We used the NBA marine report classification were habitats were classified as "Zero protection" if there was no formal protection; as "Hardly protected" if under 5% of target was met in protected areas; as "Poorly protected" if from 5% to just under 50% of biodiversity target is met in protected areas; as "Moderately protected" if from 50% to just under 100% of the biodiversity target is met in protected areas; and as "Well protected" if the biodiversity target is fully met and 15% of that habitat type is met in no-take zones.

boundary length modifier to ensure the production of an appropriately clumped output without becoming unnecessarily spatially inefficient. Secondly, the prioritisation filter focussed on identifying larger "Primary Focus Areas" and a set of smaller mostly inshore and coastal "Secondary Focus Areas" (see Box 2 for details), rather than highlighting a scatter of individual priority grid cells.

Figure 10 summarizes the general approach and methodology to spatial prioritisation used in this study. The approach follows a number of steps. Firstly, key input data on biodiversity features are collated (Section 3.2.1), as are data on pressures and current condition of habitats (Section 3.2.2), and the existing protected areas (Section 3.2.3). In addition, quantitative targets are set for how much of each biodiversity feature is required in the reserve network (Section 3.3). The initial data are used to identify the areas of least cost to industry (Section 3.2.5), and minimise overlap between proposed focus areas for protection and existing use of the environment by a range of industry sectors (Cost data represent the intensity of industry activity, such as fisheries, mining, petroleum or shipping, in a particular area). These components are iteratively combined in Marxan to identify the priority areas for inclusion in the protected area network (examined in Section 4). Some additional technical details of the prioritisation process are given in Box 2.

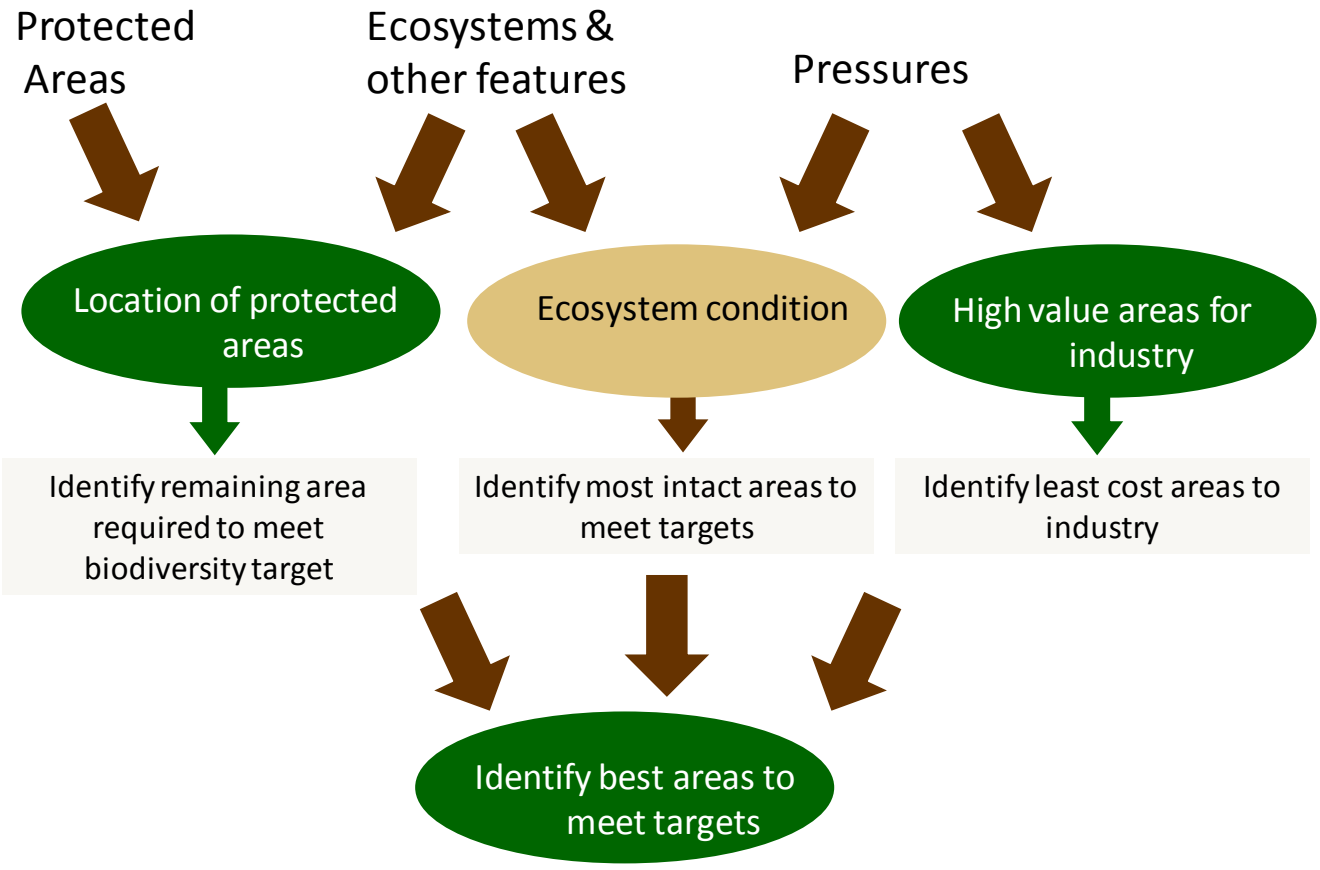

Figure 10: *Overview of spatial prioritization process.*

Box 2*: Technical details of the spatial prioritization*

- Data layers were prepared using ESRI ArcGIS 10.
- Data, targets and cost surfaces were inputted into the Marxan decision support tool using the CLUZ interface in ArcView 3.2 developed by Dr. Bob Smith, Durrell Institute of Conservation and Ecology.
- The analysis used Marxan version 1.8.10.
- The analysis followed standard Marxan processes as outlined in the ***Marxan good practices handbook***: Ardron, J. H.P. Possingham and C.J. Klein (Eds.), Version 2, 2010. Marxan good practices handbook. University of Queensland, St. Lucia, Queensland, Australia, and Pacific Marine Analysis and Research Association, Vancouver, British Columbia, Canada.
- The final cost surface was produced using the following formula: Total cost = Area + Costper*Area*1000, where "Costper" = Equal weighted sum of the individual pressure layers for a planning unit, and where "Area" is the area of the planning unit in hectares.
- An iterative approach was used to identify appropriate SPF values and Boundary Length Modifiers. Satisfactory inclusion of biodiversity features was obtained using an SPF value of 1 000 000 and a BLM of 1.1.
- Once we had a stable site selection frequency output from Marxan, we needed to develop a set of priority focus areas for the project. To do this, we took the most frequently selected planning units (areas selected 80% or more of the time) and dissolved these into contiguous units. If a unit had a total area of more than 360km^2, then any additional adjacent planning units which were selected more than 60% of the time were combined with it, to produce a "Primary Focus Area". A set of smaller mostly inshore and coastal "Secondary Focus Areas" were identified using the same method as for "Primary Focus Areas", but using a size threshold of greater than or equal to 192km^2. Again, additional adjacent planning units which were selected more than 60% of the time were combined with the core higher value units to produce "Secondary Focus Areas".

4 Identification of Priority Areas:

The basic output of the Marxan-based process described in Section 3 is a selection frequency map (Figure 11). This map gives an idea of how important each grid square is for meeting targets, and summarising the number of times (expressed as a percentage) that a grid square is included in potential spatial configurations which meet the targets and minimise costs according to the parameters used in the Marxan analysis.

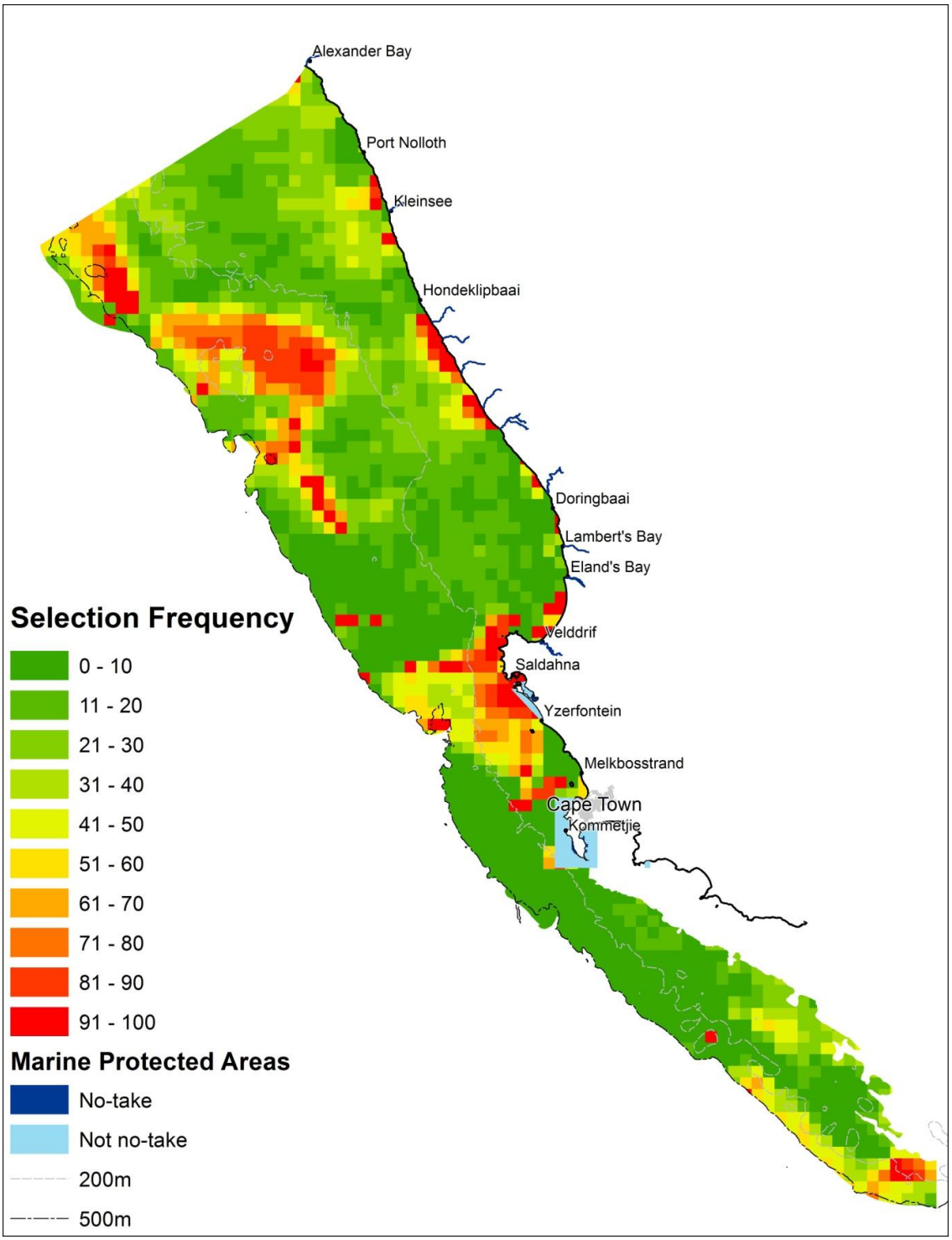

***Figure 11**: Marxan selection frequency in percent for planning units.*

Figure 12 shows how a variety of existing MPA proposals and the OMPA identified priorities compare with the results of the current study. There is strong overlap between the areas highlighted by the selection frequency map and the Cape Canyon and Child's Bank focus areas for offshore protection as identified by the OMPA project (Sink *et al.* 2011). There is strong overlap between the areas highlighted by the selection frequency map and the Namaqua Potential MPA, and slightly weaker overlap with the original proposed Namaqualand MPA and the alternative industry proposed MPA on the Namibian border.

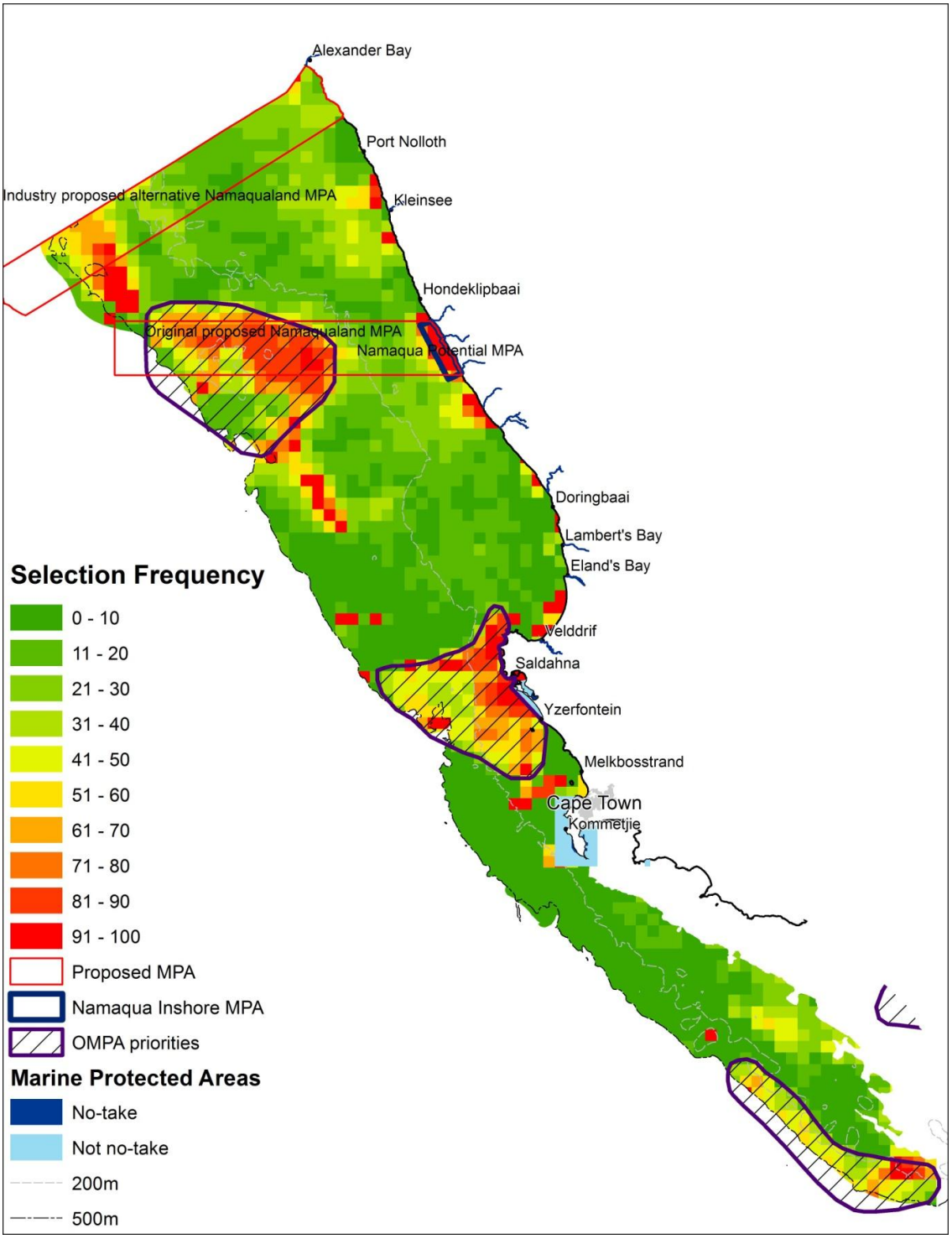

Figure 12: *Existing OMPA priorities and proposed MPAs overlaid on the Marxan selection frequency in percent for planning units.*

Although the selection frequency map is a technically useful product, it is often not very helpful in identifying focus areas for implementation actions. Therefore a set of consolidated larger "Primary Focus Areas" and a set of smaller mostly inshore and coastal "Secondary Focus Areas" were developed (see Box 2 in Section 3 for details), rather than highlighting a scatter of individual priority grid cells. Six larger "Primary Focus Areas" were identified (Figure 13):

- Child's Bank
- Benguela Hard Grounds
- Namaqua MPA
- Brown's Bank
- West Coast Consolidation
- Namibian Border

Four additional smaller coastal and inshore "Secondary Focus Areas" were identified (Figure *13*):

- North of Kleinsee
- Rietpoort
- Velddrift
- Offshore of Dassen Island

These areas are focus areas within which targets can efficiently be met. They should, however, not be treated as protected area boundaries. Ideally once significant implementation progress has been made in a number of the focus areas, one would then re-run the Marxan analysis to update the set of priority areas. Table 5 details the habitat types in the West Coast Planning domain, showing the amount of area of each habitat types found in each focus area. Although the focus areas should not be seen as protected area boundaries, the potential area of protection, percentage of target potentially met, and potential protection level of each type was analysed assuming the entire focus area was protected in each case. This analysis indicates that should the focus areas be implemented, that there would be a significant improvement in protection levels for the West Coast[2]. Currently, of the 42 benthic and coastal types found within the planning domain, 18 have Zero protection, 4 are Hardly Protected, 6 are Poorly Protected, 14 are Moderately Protected and none are Well Protected. Should the focus areas be implemented, only 2 types would have Zero Protection, 1 type would be Hardly Protected, 3 types would be Poorly Protected, 8 types would be Moderately Protected and 28 types would be Well Protected.

The Primary and Secondary Focus Areas were examined in terms of the presence of threatened habitat types (Table 4) and in terms of the number of types where a significant potential contribution to meeting targets exists (Table 5). This desktop prioritisation (which does not in any way take implementation realities into account) indicates that:

[2] We used the NBA marine report classification were habitats were classified as "Zero protection" if there was no formal protection; as "Hardly protected" if under 5% of target was met in protected areas; as "Poorly protected" if from 5% to just under 50% of biodiversity target is met in protected areas; as "Moderately protected" if from 50% to just under 100% of the biodiversity target is met in protected areas; and as "Well protected" if the biodiversity target is fully met and 15% of that habitat type is met in no-take zones. We also assumed that where a type was sufficiently included in MPAs but did not have sufficient no-take zones, that this situation was rectified during the MPA expansion process.

- In terms of presence of threatened habitat types, the West Coast Consolidation (with 19 threatened types) and the Namaqua MPA (with 7 threatened types) stand out from the remaining focus areas where generally a maximum of 3 or 4 threatened types are found.
- In terms of potential to meet targets for the greatest number of habitat types, again the West Coast Consolidation (with significant areas of 24 types) and the Namaqua MPA (with significant areas of 14 types) are the two clear highest scoring areas. Rietpoort, North of Kleinzee and the Child's Bank areas also score well when using this criterion.

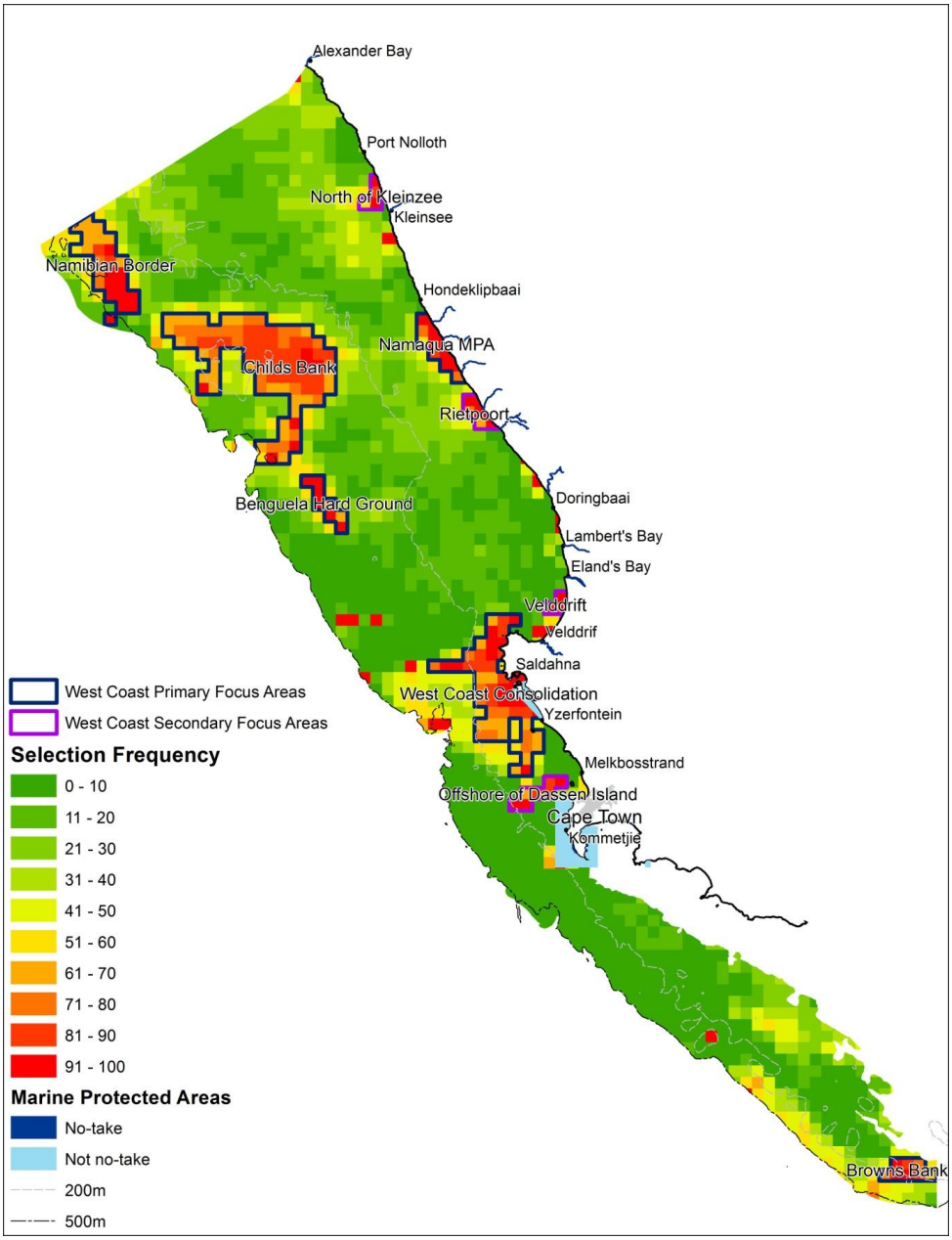

Figure 13: *Larger "Primary Focus Areas" and a set of smaller mostly inshore and coastal "Secondary Focus Areas" identified in this project.*

Table 3: Details on the habitat types in the West Coast Planning domain, showing the areas type found in each focus area. The potential area of protection, percentage of target met and potential protection level of each type is given assuming the entire focus area was protected.

				Current Protection (km^2)				Current protection		Area of each habitat type in focus areas (km^2)											Potential situtuation if focus areas implemented		
Habitat	Ecosystem Threat Status	Total area (km^2)	Target (km^2)	Not no-take	No-take	Terrestrial	Total current protection	Current protection percentage	Current Protection Level	Benguela Hard Ground	Browns Bank	Childs Bank	Namaqua MPA	Namibian Border	North of Kleinzee	Offshore of Dassen Island	Rietpoort	Velddrift	West Coast Consolidation	Grand Total	Total potential protection (km^2)	Target percentage	Potential status
Namaqua Boulder Shore	CR	0.6	0.1				0.0	0.0	Zero protection										0.6	0.6	0.6	500.0	Well protected
Namaqua Exposed Rocky Coast	LT	146.3	29.3			9.7	9.7	33.3	Poorly protected				21.3		3.6		8.5		2.3	35.6	45.3	154.9	Well protected
Namaqua Hard Inner Shelf	LT	2656.4	531.3				0.0	0.0	Zero protection				259.4						186.6	446.0	446.0	83.9	Moderately protected
Namaqua Inner Shelf Reef	CR	0.9	0.2				0.0	0.0	Zero protection										0.9	0.9	0.9	474.7	Well protected
Namaqua Inshore Hard Grounds	CR	233.0	46.6				0.0	0.0	Zero protection				23.3					0.0	7.0	30.3	30.3	65.0	Moderately protected
Namaqua Inshore Reef	CR	3.4	0.7				0.0	0.0	Zero protection				0.0							0.0	0.0	5.8	Poorly protected
Namaqua Island	CR	280.0	56.0			0.2	0.2	0.4	Hardly protected										110.7	110.7	110.9	198.1	Well protected
Namaqua Mixed Shore	EN	241.2	48.2			10.5	10.5	21.8	Poorly protected				15.4		10.3		16.3		6.3	48.3	58.8	121.8	Well protected
Namaqua Muddy Inner Shelf	LT	11165.6	2233.1				0.0	0.0	Zero protection				240.3		101.8		104.4	7.4	50.7	504.6	504.6	22.6	Poorly protected
Namaqua Muddy Inshore	VU	164.4	32.9				0.0	0.0	Zero protection				0.1					34.7		34.8	34.8	105.8	Well protected
Namaqua Sandy Inner Shelf	LT	5394.5	1078.9				0.0	0.0	Zero protection				76.7		136.6		201.8	96.4	241.3	752.8	752.8	69.8	Moderately protected
Namaqua Sandy Inshore	CR	823.9	164.8				0.0	0.0	Zero protection				92.5		26.5		48.6	55.6	0.0	223.2	223.2	135.4	Well protected
Namaqua Sheltered Rocky Coast	CR	9.3	1.9			0.0	0.0	2.5	Hardly protected				0.2		1.2		0.1		0.1	1.6	1.6	87.7	Moderately protected
Namaqua Very Exposed Rocky Coast	VU	12.0	2.4			0.3	0.3	13.1	Poorly protected				1.9				0.7		0.1	2.6	3.0	123.4	Well protected
Southern Benguela Canyon	CR	785.9	157.2				0.0	0.0	Zero protection										33.1	33.1	33.1	21.0	Poorly protected
Southern Benguela Carbonate Mound	LT	1449.2	289.8				0.0	0.0	Zero protection			602.9								602.9	602.9	208.0	Well protected
Southern Benguela Dissipative Sandy Coast	LT	68.9	13.8	11.5		6.5	18.0	130.5	Moderately protected									5.8	0.4	6.2	24.1	175.2	Well protected
Southern Benguela Dissipative-Intermediate Sanc	LT	120.3	24.1	8.9	0.7	12.0	21.6	89.8	Moderately protected				5.7		2.7			13.6	3.9	25.8	47.4	196.9	Well protected
Southern Benguela Estuarine Shore	LT	12.1	2.4	0.1	0.3	3.8	4.2	174.8	Moderately protected				0.2				0.1			0.3	4.5	187.2	Well protected
Southern Benguela Gravel Outer Shelf	CR	433.4	86.7				0.0	0.0	Zero protection		162.7									162.7	162.7	187.7	Well protected
Southern Benguela Gravel Shelf Edge	CR	29.9	6.0				0.0	0.0	Zero protection												0.0	0.0	Zero protection
Southern Benguela Hard Outer Shelf	VU	10612.9	2122.6	47.9			47.9	2.3	Hardly protected	271.2	68.9	527.1		253.8		58.1			192.8	1371.9	1419.8	66.9	Moderately protected
Southern Benguela Hard Shelf Edge	CR	4532.0	906.4				0.0	0.0	Zero protection	239.5		254.9		412.9					0.9	908.1	908.1	100.2	Well protected
Southern Benguela Intermediate Sandy Coast	LT	123.8	24.8	0.4	0.1	4.8	5.3	21.5	Poorly protected				2.3		0.3		4.2		9.2	16.0	21.4	86.2	Moderately protected
Southern Benguela Muddy Outer Shelf	LT	6054.3	1210.9				0.0	0.0	Zero protection			33.9								33.9	33.9	2.8	Hardly protected
Southern Benguela Muddy Shelf Edge	CR	567.3	113.5				0.0	0.0	Zero protection												0.0	0.0	Zero protection
Southern Benguela Outer Shelf Reef	EN	1.6	0.3				0.0	0.0	Zero protection							0.4				0.4	0.4	125.0	Well protected
Southern Benguela Reflective Sandy Coast	LT	47.1	9.4	0.0	0.0	2.4	2.4	25.9	Poorly protected				0.7		0.2		1.1		6.2	8.3	10.7	113.5	Well protected
Southern Benguela Sandy Outer Shelf	LT	56231.7	11246.3	15.0			15.0	0.1	Hardly protected	22.5	317.5	4480.7		42.1		142.0			1060.0	6064.8	6079.8	54.1	Moderately protected
Southern Benguela Sandy Shelf Edge	VU	13237.7	2647.5				0.0	0.0	Zero protection	50.4		425.2		1164.0						1639.6	1639.6	61.9	Moderately protected
Southwestern Cape Boulder Shore	CR	19.9	4.0	4.0	0.0	3.9	7.9	199.1	Moderately protected										2.8	2.8	10.7	269.2	Well protected
Southwestern Cape Exposed Rocky Coast	EN	50.5	10.1	11.3	1.4	12.2	24.9	246.7	Moderately protected										12.0	12.0	36.9	365.1	Well protected
Southwestern Cape Hard Inner Shelf	EN	1317.8	263.6	157.8	0.0		157.9	59.9	Moderately protected							227.0			509.0	736.0	893.9	339.2	Well protected
Southwestern Cape Inshore Hard Grounds	CR	51.3	10.3	27.9	4.2		32.1	312.8	Moderately protected										2.5	2.5	34.6	337.4	Well protected
Southwestern Cape Inshore Reef	CR	5.7	1.1	5.0	0.3		5.3	465.5	Moderately protected												5.3	465.5	Well protected
Southwestern Cape Island	EN	1045.9	209.2	89.5	0.3	2.7	92.4	44.2	Poorly protected							53.0			479.2	532.2	624.6	298.6	Well protected
Southwestern Cape Lagoon	VU	129.1	25.8	36.2	10.6	18.4	65.2	252.6	Moderately protected										63.9	63.9	129.1	500.0	Well protected
Southwestern Cape Mixed Shore	VU	49.0	9.8	9.0	3.4	10.4	22.7	231.7	Moderately protected										3.9	3.9	26.6	271.4	Well protected
Southwestern Cape Sandy Inner Shelf	LT	1652.1	330.4	286.5			286.5	86.7	Moderately protected							18.4			475.7	494.0	780.6	236.2	Well protected
Southwestern Cape Sandy Inshore	VU	206.8	41.4	103.1	0.3		103.4	250.0	Moderately protected										14.2	14.2	117.6	284.2	Well protected
Southwestern Cape Sheltered Rocky Coast	CR	1.1	0.2	0.2		0.2	0.4	201.5	Moderately protected												0.4	201.5	Well protected
Southwestern Cape Very Exposed Rocky Coast	CR	1.4	0.3	1.0		0.4	1.4	500.0	Moderately protected												1.4	500.0	Well protected

Table 4: Evaluation of threatened habitats found in each focus area.

Habitat		Presence of threatened habitat types									
		Benguela Hard Ground	Browns Bank	Childs Bank	Namaqua MPA	Namibian Border	North of Kleinzee	Offshore of Dassen Island	Rietpoort	Velddrift	West Coast Consolidation
Namaqua Boulder Shore											CR
Namaqua Exposed Rocky Coast					LT		LT		LT		LT
Namaqua Hard Inner Shelf					LT						LT
Namaqua Inner Shelf Reef											CR
Namaqua Inshore Hard Grounds					CR					CR	CR
Namaqua Inshore Reef					CR						
Namaqua Island											CR
Namaqua Mixed Shore					EN		EN		EN		EN
Namaqua Muddy Inner Shelf					LT		LT		LT	LT	LT
Namaqua Muddy Inshore					VU					VU	
Namaqua Sandy Inner Shelf					LT		LT		LT	LT	LT
Namaqua Sandy Inshore					CR		CR		CR	CR	CR
Namaqua Sheltered Rocky Coast					CR		CR		CR		CR
Namaqua Very Exposed Rocky Coast					VU				VU		VU
Southern Benguela Canyon											CR
Southern Benguela Carbonate Mound				LT							
Southern Benguela Dissipative Sandy Coast										LT	LT
Southern Benguela Dissipative-Intermediate Sandy Coast					LT		LT			LT	LT
Southern Benguela Estuarine Shore					LT				LT		
Southern Benguela Gravel Outer Shelf			CR								
Southern Benguela Gravel Shelf Edge											
Southern Benguela Hard Outer Shelf		VU	VU	VU		VU		VU			VU
Southern Benguela Hard Shelf Edge		CR		CR		CR					CR
Southern Benguela Intermediate Sandy Coast					LT		LT		LT		LT
Southern Benguela Muddy Outer Shelf				LT							
Southern Benguela Muddy Shelf Edge											
Southern Benguela Outer Shelf Reef								EN			
Southern Benguela Reflective Sandy Coast					LT		LT		LT		LT
Southern Benguela Sandy Outer Shelf		LT	LT	LT		LT		LT			LT
Southern Benguela Sandy Shelf Edge		VU		VU		VU					
Southwestern Cape Boulder Shore											CR
Southwestern Cape Exposed Rocky Coast											EN
Southwestern Cape Hard Inner Shelf								EN			EN
Southwestern Cape Inshore Hard Grounds											CR
Southwestern Cape Inshore Reef											
Southwestern Cape Island								EN			EN
Southwestern Cape Lagoon											VU
Southwestern Cape Mixed Shore											VU
Southwestern Cape Sandy Inner Shelf								LT			LT
Southwestern Cape Sandy Inshore											VU
Southwestern Cape Sheltered Rocky Coast											
Southwestern Cape Very Exposed Rocky Coast											
Totals	CR	1	1	1	4	1	2	0	2	2	10
	EN	0	0	0	1	0	1	3	1	0	4
	VU	2	1	2	2	2	0	1	1	1	5
	Total Threatened	3	2	3	7	3	3	4	4	3	19

Table 5: Evaluation of potential to meet targets in each focus area. Highlighted blocks indicate where more than 5% of the target for a habitat type can be met in a focus area.

		Target percentage in each focus area									
Habitat	Current Protection Level	Benguela Hard Ground	Browns Bank	Childs Bank	Namaqua MPA	Namibian Border	North of Kleinzee	Offshore of Dassen Island	Rietpoort	Velddrift	West Coast Consolidation
Namaqua Boulder Shore	Zero protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	500.0
Namaqua Exposed Rocky Coast	Poorly protected	0.0	0.0	0.0	72.7	0.0	12.1	0.0	28.9	0.0	7.9
Namaqua Hard Inner Shelf	Zero protection	0.0	0.0	0.0	48.8	0.0	0.0	0.0	0.0	0.0	35.1
Namaqua Inner Shelf Reef	Zero protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	474.7
Namaqua Inshore Hard Grounds	Zero protection	0.0	0.0	0.0	49.9	0.0	0.0	0.0	0.0	0.0	15.0
Namaqua Inshore Reef	Zero protection	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0
Namaqua Island	Hardly protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	197.7
Namaqua Mixed Shore	Poorly protected	0.0	0.0	0.0	31.9	0.0	21.3	0.0	33.7	0.0	13.1
Namaqua Muddy Inner Shelf	Zero protection	0.0	0.0	0.0	10.8	0.0	4.6	0.0	4.7	0.3	2.3
Namaqua Muddy Inshore	Zero protection	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	105.5	0.0
Namaqua Sandy Inner Shelf	Zero protection	0.0	0.0	0.0	7.1	0.0	12.7	0.0	18.7	8.9	22.4
Namaqua Sandy Inshore	Zero protection	0.0	0.0	0.0	56.2	0.0	16.1	0.0	29.5	33.8	0.0
Namaqua Sheltered Rocky Coast	Hardly protected	0.0	0.0	0.0	9.1	0.0	62.8	0.0	7.4	0.0	5.8
Namaqua Very Exposed Rocky Coast	Poorly protected	0.0	0.0	0.0	77.8	0.0	0.0	0.0	30.3	0.0	2.2
Southern Benguela Canyon	Zero protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0
Southern Benguela Carbonate Mound	Zero protection	0.0	0.0	208.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Benguela Dissipative Sandy Coast	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.9	2.8
Southern Benguela Dissipative-Intermediate Sandy	Moderately protected	0.0	0.0	0.0	23.5	0.0	11.1	0.0	0.0	56.5	16.1
Southern Benguela Estuarine Shore	Moderately protected	0.0	0.0	0.0	6.7	0.0	0.0	0.0	5.7	0.0	0.0
Southern Benguela Gravel Outer Shelf	Zero protection	0.0	187.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Benguela Gravel Shelf Edge	Zero protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Benguela Hard Outer Shelf	Hardly protected	12.8	3.2	24.8	0.0	12.0	0.0	2.7	0.0	0.0	9.1
Southern Benguela Hard Shelf Edge	Zero protection	26.4	0.0	28.1	0.0	45.6	0.0	0.0	0.0	0.0	0.1
Southern Benguela Intermediate Sandy Coast	Poorly protected	0.0	0.0	0.0	9.3	0.0	1.4	0.0	17.0	0.0	37.0
Southern Benguela Muddy Outer Shelf	Zero protection	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Benguela Muddy Shelf Edge	Zero protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Benguela Outer Shelf Reef	Zero protection	0.0	0.0	0.0	0.0	0.0	0.0	125.0	0.0	0.0	0.0
Southern Benguela Reflective Sandy Coast	Poorly protected	0.0	0.0	0.0	7.8	0.0	2.2	0.0	12.0	0.0	65.6
Southern Benguela Sandy Outer Shelf	Hardly protected	0.2	2.8	39.8	0.0	0.4	0.0	1.3	0.0	0.0	9.4
Southern Benguela Sandy Shelf Edge	Zero protection	1.9	0.0	16.1	0.0	44.0	0.0	0.0	0.0	0.0	0.0
Southwestern Cape Boulder Shore	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.1
Southwestern Cape Exposed Rocky Coast	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.4
Southwestern Cape Hard Inner Shelf	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	86.1	0.0	0.0	193.1
Southwestern Cape Inshore Hard Grounds	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.6
Southwestern Cape Inshore Reef	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southwestern Cape Island	Poorly protected	0.0	0.0	0.0	0.0	0.0	0.0	25.3	0.0	0.0	229.1
Southwestern Cape Lagoon	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	247.4
Southwestern Cape Mixed Shore	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.7
Southwestern Cape Sandy Inner Shelf	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	144.0
Southwestern Cape Sandy Inshore	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.2
Southwestern Cape Sheltered Rocky Coast	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southwestern Cape Very Exposed Rocky Coast	Moderately protected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of types where more than 5% of target present		2	1	5	14	3	6	4	9	5	24

Figure 14 overlays the areas of threatened habitat areas still in good condition with the identified priority areas of this plan.

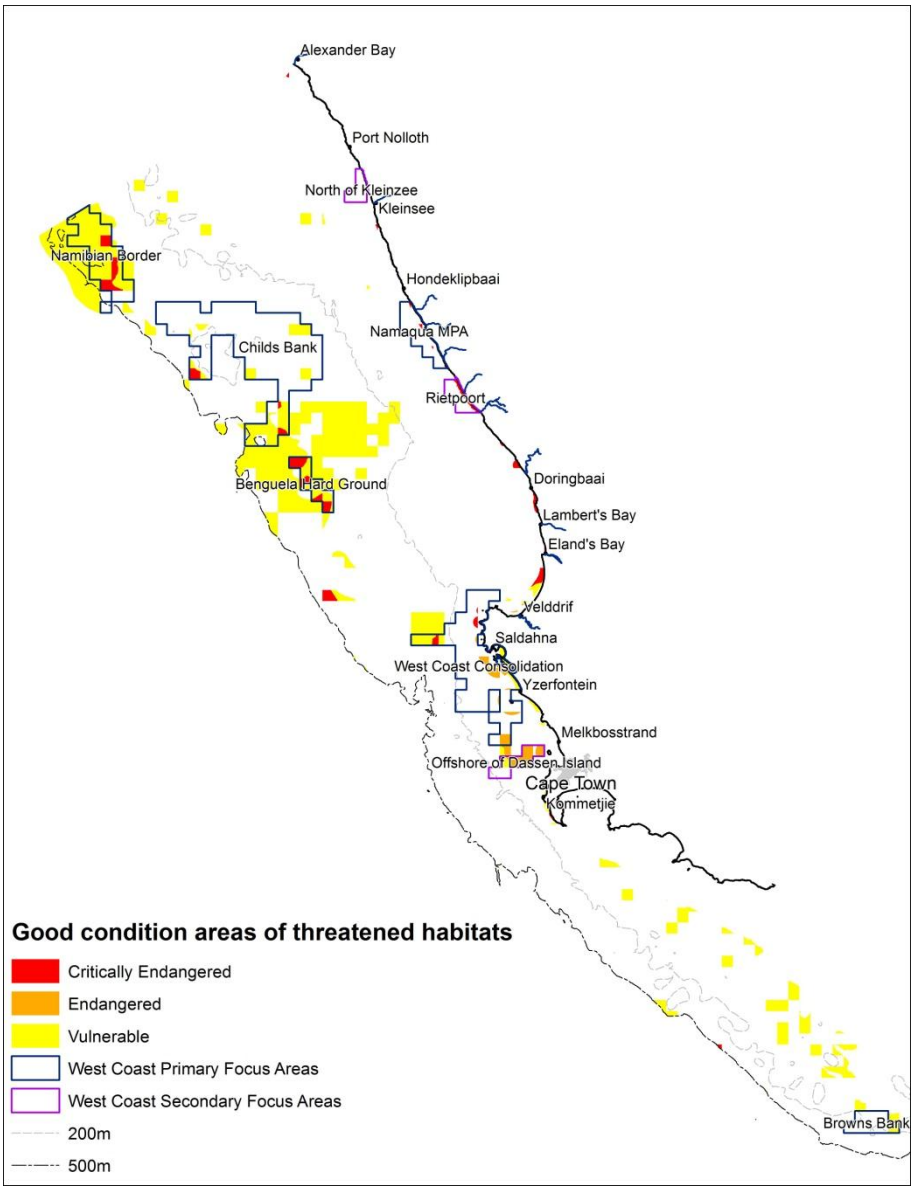

***Figure 14**: Map illustrating the good condition areas of threatened habitat captured in the Larger "Primary Focus Areas" and smaller "Secondary Focus Areas" identified in this project.*

4.1 West Coast Consolidation:

This focus area makes the greatest contribution to habitat targets of all the focus areas identified in the plan, contributing to meeting more than 5% of targets for 24 of its 28 habitat types. The area spans two ecoregions and includes coastal, inshore and offshore habitat types making it the most spatially efficient area. Selection is also driven by targets for threatened marine species as it provides coverage for all threatened species included in the plan. Five existing MPAs (Jutten, Malgas and Marcus Islands, Sixteen Mile Beach and Langebaan) as well as the Cape Canyon focus area for offshore protection (Sink *et al.* 2011) are included in this area, and these could be consolidated into a network of spatial management measures including a large, zoned MPA. This is the only focus area where targets for the Namaqua Boulder Shore (Critically Endangered) and

Southern Benguela Canyon (Critically Endangered) can be met. Additional threatened habitat types that require protection within this area include Namaqua inner shelf reef (Critically Endangered).

4.2 Proposed Namaqua Marine Protected Area

The selection of this area is driven by its ability to meet habitat targets for 14 habitat types (Table 5) including Critically Endangered habitat types such as Namaqua Inshore Reef, Namaqua Inshore Hard Grounds and Namaqua Sandy Inshore. The area has low to moderate cost values with boat based diamond mining by scuba divers being the main contributor to cost in this area. Adjacency to the Namaqua National Park is also a key driver of selection. The Groen and the Spoeg estuaries are also driving selection in this area, as they were identified in the NBA Estuary Component as priority estuaries (Van Niekerk and Turpie 2012).

4.3 North of Kleinzee

This area makes a major contribution to the potential protection of six habitat types, all of which are also present in the Proposed Namaqua MPA. Three of these habitat types are threatened – Namaqua Mixed Shore which is Endangered, and Namaqua Sandy Inshore and Namaqua Sheltered Rocky Coast which are both considered Critically Endangered. Selection of this focus area is also driven by the moderate cost and associated areas of fair habitat condition.

4.4 Rietpoort

The Rietpoort focus area situated between the Sout and the Brak Rivers contributes to targets for nine habitat types, all of which are also included in the Proposed Namaqua MPA focus area. The Critically Endangered habitats in this area are Namaqua Sandy Inshore and Namaqua Sheltered Rocky Coast. Significantly this area is the only stretch of the Northern Cape coastline that is in a good habitat condition (Figure 8). The high selection frequency is driven by condition as well as the associated low cost values in this area. Very little mining has taken place in this area although there are rights holders with leases (see Section 5).

4.5 Childs Bank

This focus area makes significant contributions to five habitat targets, including the Southern Benguela Hard Shelf Edge (Critically Endangered) and Southern Benguela Sandy Shelf Edge (Vulnerable). The submarine bank for which this focus area is named is considered a potential VME and is a key driver of the selection frequency of this area. A secondary driver is habitat condition, as the majority of the area is in a good condition. This area was also identified by Sink *et al.* 2011 as a priority area.

4.6 Velddrif

The Velddrif focus area makes a significant contribution to three threatened habitat types: the Critically Endangered habitats Namaqua Sandy Inshore and Namaqua Sheltered Rocky Coast, and the Vulnerable habitat Namaqua Muddy Inshore, all of which are found in the Proposed Namaqua MPA focus area. This area has significant implementation challenges as there is a large community of recreational fisherman as well as 80 gill net licence holders in the area. This area is shown in Figure 9 as having a moderate cost and in conjunction (Figure 8) to be in a good and fair habitat condition. However these are relics of the lack of information on net fishing and recreational fishing available at the time of data processing during the NBA analyses.

4.7 Offshore of Dassen Island

This area contributes significantly to the protection of four threatened habitat types, including the Vulnerable habitat Southern Benguela Hard Inner Shelf and the Endangered habitat types Southern Benguela Outer Shelf Edge, Southwestern Cape Exposed Rocky Coast and South Western Cape Island. Selection is also being driven by targets for threatened species, as the area would provide respite for Cape and Bank Cormorants, African Penguins and Gannets. Habitat condition may also play a role in selection as the entirety of the area is in a good condition (Figure 8).

4.8 Namibian border

This area makes considerable contribution to targets for three habitat types including the Critically Endangered habitat type Southern Benguela Hard Shelf. This area represents one of the few places along the shelf edge where threatened habitat types are in a good condition. Habitat condition is therefore a major driver of selection in this area, along with the associated low cost in this area. It should be noted that this area has the lowest cost value than any other area on the shelf edge.

4.9 Benguela hard ground

This focus area makes a significant contribution to the protection of two habitat types, with the major driver of selection being threatened habitats in good habitat condition, with associated moderate cost. This area contributes to targets for the Southern Benguela Hard Shelf edge, which is Critically Endangered, as well as making a minor contribution to targets for Southern Benguela Sandy Shelf Edge, both of which have Zero Protection.

4.10 Browns Bank

This focus area is strongly driven by biodiversity representation, as it is the only area where targets for Southern Benguela Gravel Outer Shelf (which is Critically Endangered with Zero Protection) can be met. It should be noted that this habitat type has a limited extent and no areas that are considered in a good habitat condition remain. This area also makes a minor contribution to targets for Southern Benguela Hard Outer Shelf, which is Vulnerable and Hardly Protected.

5 Next Steps:

Nine focus areas have been identified for implementation (Figure 15). Implementation of these focus areas will need to be site specific with a need for increased effort in stakeholder engagement and finer-scale interrogation of spatial data to determine proposed boundaries and zonation. All offshore identified focus areas (Childs Bank, Namibian Border, Benguela Hard Grounds, Offshore of Dassen Island and Browns Bank) should be taken forward through the OMPA implementation process, and therefore will not be discussed here.

The West Coast Consolidation focus area has a coastal component but also overlaps with the Cape Canyon focus area for offshore protection. Consolidation, rationalisation and expansion is recommended within this focus area. A broader consolidated network of spatial management measures should be developed in consultation with government, industry, community and conservation agency stakeholders. MPAs and Fishery Management Areas should be considered. Small pelagic fisheries, demersal trawl, longline and linefishers are key fisheries stakeholders in this regard. With regard to the small pelagic fishery, there may be scope for negotiation regarding existing MPAs such as the Sixteen Mile Beach MPA during consolidation and expansion within this broad area.

The Velddrif area is not being proposed for implementation owing to the implementation challenges linked to the substantial numbers of recreational fishermen and gill net licence holders (80 rights holders) in the area. Groundtruthing is needed in this area to validate ecosystem condition considering the absence of netfish data and poor recreational fishing intensity data available for use in the National Biodiversity Assessment (Sink *et al.* 2012). These data sets have been prioritised for future use and improvement in future assessments and plans (Sink *et al.* 2012). This area was previously proclaimed as the Rocherpan MPA, but after much deliberation around the areas management strategy, a scoring exercise was undertaken and the area was de-proclaimed (George Branch and Colin Attwood, pers. comms).

The priority coastal areas that are recommended to be taken forward are the Proposed Namaqua MPA focus area, Rietpoort focus area, and the focus area North of Kleinzee.

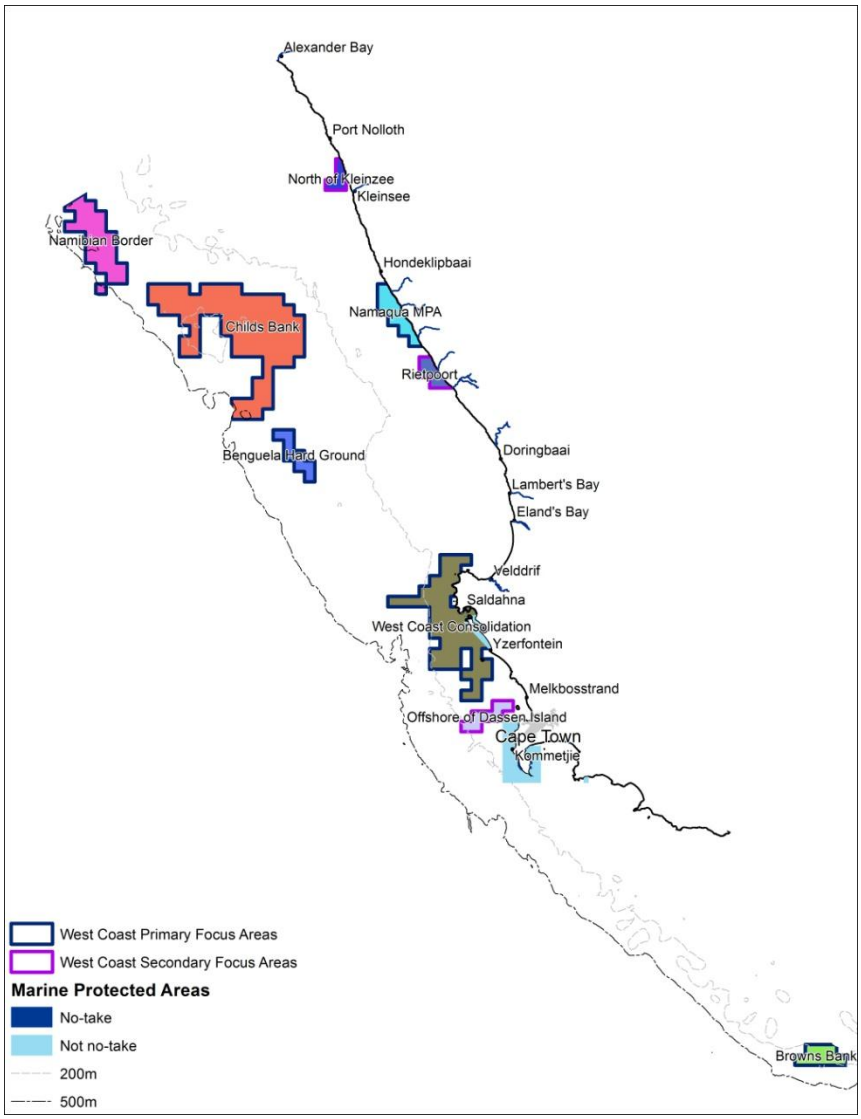

***Figure 15**: Nine focus areas for protection on the west coast as identified by a systematic marine biodiversity plan.*

Key stakeholders are listed in Table 6, along with identified issues for consideration around implementation. The Namaqua MPA and Rietpoort areas are recommended for first implementation of a zoned contiguous coastal MPA followed by the area North of Kleinzee. Consolidation, rationalisation and expansion is recommended within the West Coast Consolidation focus area

which also overlaps with the Cape Canyon focus area identified through the Offshore MPA project. The Childs Bank area is currently flagged for the implementation of an experimental closure. Other offshore priorities should be used to advance the implementation of offshore MPAs through the SeaChange project.

Table 6: List of stakeholders for engagement around implementation of identified focus areas and other considerations.

Focal area name	Key stakeholders	Other implementation considerations
Namaqua	– DMR – Petroleum Agency South Africa – Namagroen (Concessions 8a and 8b) – De Beers Consolidated Mines Ltd – Mr JC Pansegrouw (9b) – Thombo Petroleum – SAN Parks – Recreational fishers – Coastal municipality – Tour operators	Diamond or other mineral mining leases include 8a, 8b, 8c, 9a, 9b, 9c Namagroen lease area 9a is a conversion in process. 9c - De Beers consolidated for gold, heavy minerals, platinum, sapphire, and PGMs
Rietpoort	– DMR – Petroleum Agency South Africa – De Beers Consolidated Mines Ltd (10c) – Forest International – PetroSA – Anschutz – Baggers (Edms) Bpk (10a and 10b) – Sanparks – Recreational fishers – Coastal municipality – Adjacent land owners (mostly sheep farming)	Mining rights in areas 10a, 10b and 10c. Petroleum block 2a is a production right, 2b is for exploration, whilst 3a is open. Proposed pipeline landing point south of the Groen River Coastal area has moderate recreational use with recreational rock lobster diving, but is in a very good condition. 3a and 4a held by BHP Billiton have recently excluded the coastal areas from these exploration rights areas.
N of Kleinzee	– DMR – Petroleum Agency South Africa – PetroSA	Mining areas 4a and 4b. Petroleum lease area 1 is an exploration right.

As outlined in Section 2, the major obstacle to proclamation of the proposed Namaqua MPA is the existence of mining rights and current diver based mining within the area. SAN Parks is poised to implement marine management in the sea area adjacent to the existing Namaqua National Park as the coastal section is already managed as part of the park (Figure 16). The establishment of stronger working relationships between the DEA and DMR could help to carve a way forward in opening negotiations between these two government departments, as the recent Namaqua workshop held in Okiep established that the only direct conflict exists with the mining and petroleum sectors. No conflicts exist with the local communities and recreational and commercial fisherman, although there is apparently very limited recreational use within the protected area.

The proposed iBhubesi pipeline landing site is just south of the Groen Estuary and high level discussion is needed to negotiate its repositioning as the current proposed location would impact not only on the proposed MPA, but could have a major impact on the terrestrial ecosystems within and adjacent to the park.

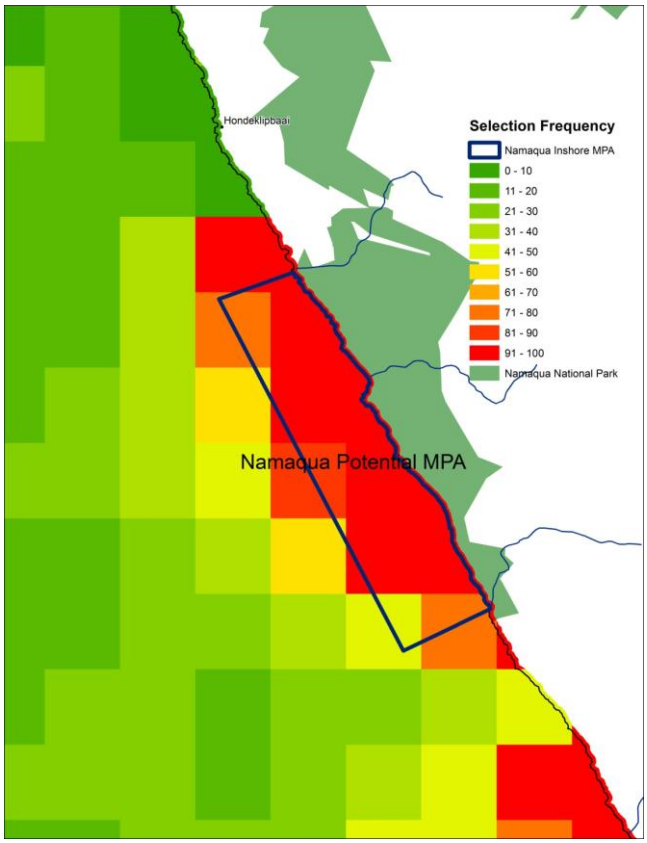

Figure 16: *The potential Namaqua MPA as proposed by SANParks for expansion of the Namaqua National Park.*

Photo 1: *The southern boundary of the existing Namaqua National Park showing the Groen River Estuary.*

Photo 2: *Kwasbaai in the Namaqua National Park. A no-take zone is recommended in this park between the Groen and Spoeg Estuaries.*

The Rietpoort focus area was revealed by this systematic biodiversity plan as the last marine area on the Northern Cape coastline in good habitat condition and as such this area is a high priority for conservation. Although there are existing lease holders within the area, available data (drawn from Penney *et al.* 2008) reflects that almost no mining has taken place in this area. The results of this plan should be discussed more broadly within SAN Parks and other relevant parties.

Photo 3*: The Rietpoort focus area should be considered as a controlled use zone for inclusion in the proposed Namaqua MPA. Limited recreational fishing occurs in this area, and the spring flower displays offer additional tourism opportunities.*

Stakeholder engagement with adjacent land-users (mostly sheep farmers) should also be initiated. The outcomes of this plan suggest that this area would benefit from inclusion into the Proposed Namaqua MPA, with potential for a no-take zone in the area between the Groen and Spoeg Rivers. It should be noted that Namakwa Sands operate just south of the Sout River with many visual and other impacts in the Brand se Baai area. Therefore it would not be beneficial to attempt to acquire the marine or terrestrial portions of this area.

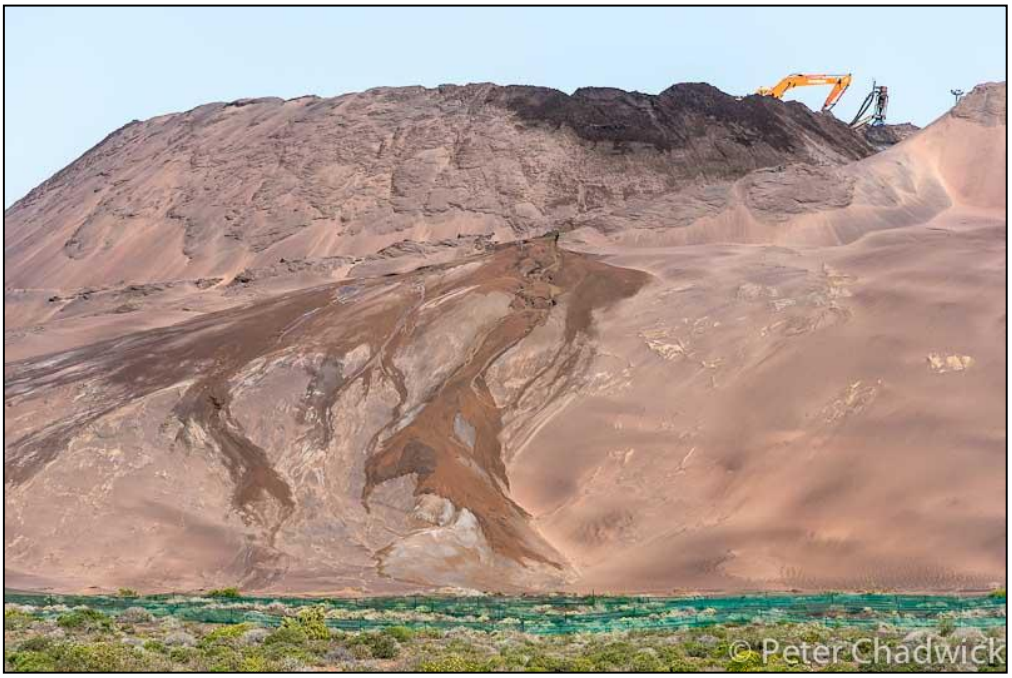

Photo 4: *Heavy mineral mining activity south of the Sout River render this area unsuitable for protected area establishment.*

A site visit to this area showed that there is rich botanical diversity in this area with further impressive spring flower displays, rivalling those within the current Namaqua National Park. Inclusion of this additional coastal strip could further diversify and strengthen tourism opportunities.

The focus area North of Kleinzee meets important biodiversity targets and could include conservation and monitoring of the Cape Fur Seal colony in that area. This seal colony is the largest in South Africa and provides opportunity for ecotourism. It currently forms part of the Diamond Route with guided tours, including shipwreck tours and other historical outings, already underway in this region. This region was previously afforded some protection as it formed part of the De Beers lease area with restricted access to the coast. Access to the coast is increasing as many diamond mining operations are closing down, emphasising the need for timeous action in this area to maintain protection and offer alternative livelihoods. It is proposed that engagement with SAN Parks be initiated to investigate where opportunities exist to link terrestrial planning in this area with this marine focus area.

Photo 5: *The seal colony at Kleinzee should be included in any MPAs established in this area because of additional socio-economic opportunities this could add the local community through ecotourism.*

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