NAMIBIAN COAST CONSERVATION
AND MANAGEMENT PROJECT
NACOMA

Vol. 2 of 3 - Draft Environmental Impact Assessment (EIA) Report for the Kuiseb Delta and Dune Belt Areas, ERONGO REGION, NAMIBIA

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Statement of Qualification of the Environmental Assessment Practitioner (EAP) Dr. Sindila Mwiya

Dr. Sindila Mwiya has been the Environmental Assessment Practitioner (EAP) for this project in accordance with the provisions of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 under the Environmental Management Act (EMA), 2007, Act No. 7 of 2007. Dr. Sindila Mwiya is highly qualified, with more than ten years of professional experience in mining, petroleum, property development, applied environmental management, cleaner production, environmental management, geoenvironmental engineering and geotechnical engineering fields.

He gained his experience from public and private employments and contracts in Namibia, and the SADC region. He has worked as a Project Manager, Lecturer (University of Namibia), External Examiner/ Moderator (Polytechnic of Namibia), Technical Consultant, National Technical Advisor and reviewer on international, national and regional (SADC) plans, programmes and projects with the objective to ensure substantial and sustainable natural resources development, management, and for development policies, plans, programmes and projects financed by governments, private investors and donor organisations. Among his academic achievements, he is a holder of a Ph.D., MPhil, PG Cert and BEng (Hons) qualifications from the University of Portsmouth in the United Kingdom. During the 2004 Namibia National Science Awards, organised by the Ministry of Education, and held in Windhoek, Namibia, Dr. Sindila Mwiya was awarded the Geologist of the Year for 2004, in the professional category.

Furthermore, as part of his professional career recognition, Dr. Sindila Mwiya is a life member of the Geological Society of Namibia, Consulting member of the Hydrogeological Society of Namibia and a Professional Engineer registered with the Engineering Council of Namibia. He possesses excellent computing, analytical, communicative, interpersonal and organisational skills. Dr Sindila Mwiya has experience, skills and technical knowledge in petroleum industry, mining industry, environment, local, regional and national land use planning, production and management of various planning thematic information, maps and related documentations, gained in local, national and regional developmental policies, plan, programmes and projects he undertook.

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- **Dr John Kinahan** Archaeology Expertise (QRS Namibia)
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LIST OF ACRONYMS

CBNRM	Community-Based Natural Resource Management
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
DST	Decision Support Tool
DNP	Dorob National Park
FGN	Foresight Group Namibia
GIS	Geographical Information System
GPS	Geographical Positioning System
ICZM	Integrated Coastal Zone Management
KDDP	Kuiseb Delta Development Project
LA	Local Authorities
LM	Line Ministries
MDP	Management and Development Plan
MET	Ministry of Environment and Tourism
NACOMA PCO	Namibia Coast Conservation and Management Project Coordinating Office
NSCNP	Namib-Skeleton Coast National Park
QRS	Quaternary Research Services
REB	Responsible Environment Behaviour
RBS	Risk-Based Solutions
RC	Regional Councils
RS	Remote Sensing
SEA	Strategic Environmental Assessment
TCB&SAP	Training & Capacity Building and Strategy Action Plan
TOR	Terms of Reference
T/A	Trading As
UCCB	University Central Consultancy Bureau
UNAM	University of Namibia

EXECUTIVE SUMMARY

1. Introduction

The Kuiseb Delta Community and investors from Walvis Bay and Swakopmund were awarded small MGs to invest in projects that support sustainable development. The proposed projects are located in the Kuiseb Delta and Dune Belt areas in Erongo Region. It is against this background that NACOMA commissioned this study on behalf of the applicants (Proponents) to conduct an Environmental Assessment (EA) covering Scoping (Vol. 1 of 3), this Environmental Impact Assessment (EIA) Vol. 2 of 3 report and develop an Environmental Management Plan (EMP) Vol. 3 of 3 report. The overall aim of the study is to reconfirm the carrying capacity of the Kuiseb Delta to community based tourism and Dune Belt Area to various conflicting resource use activities. There are also other activities in the area, such as quad-biking, cultural, sightseeing and eco-tours operating in the proposed projects and the surrounding areas. The nature and coverage of the existing and proposed activities and their likely negative impacts on the sensitive coastal environment resulted in the proposed EA study area being extended beyond the proposed projects areas to include the Dune Belt, lower Kuiseb River and Delta Area.

2. Project Developmental Stages

The proposed Kuiseb Delta and Dune Belt projects implementations process could be divided into the following development stages:

- Project Identification: Covering the actual project definition, alternative location assessments, investment levels for the small Matching Grants (MGs) for targeted investments in specific project intervention sites in ecosystems of biodiversity importance already undertaken by the NACOMA Project on behalf of the applicants (proponents);

- Feasibility study (covering all the technical studies such as assessment products, infrastructure needs, design and layout already undertaken by the NACOMA Project on behalf of the applicants (proponents);

- Environmental Assessments covering Scoping (Vol. 1 of 3), EIA Vol. 2 of 3 and EMP Vol. 3 of 3 ongoing and implemented by the NACOMA Project on behalf of the applicants (proponents);

- Preconstruction and environmental monitoring (covering site preparation, material and equipment mobilisation for the development of the supporting infrastructure and facilities for the proposed project activities and environmental performance monitoring to be implemented on receipt of the Environmental Clearance Certificates to be issued by the Environmental Commissioner;

- Construction and environmental monitoring (covering the construction of the supporting infrastructure such as access roads / tracks, walk ways, bird view decks, lodge, administration and all other supporting facilities and environmental performance monitoring to be implemented on receipt of the Environmental Clearance Certificates to be issued by the Environmental Commissioner;

- Operation, maintenance and environmental monitoring (covering the actual running of the proposed Kuiseb Delta and Dune Belt activities, maintenance of the supporting

infrastructure and environmental performance monitoring following the completion of the construction phase).

3. Environmental Requirements

The proposed Matching Grants (MGs) for targeted investments projects covering the community- based eco-tourism and bird watching activities falls within the Dorob National Park (DNP), an area with ecosystems of biodiversity importance to Namibia. In line with the Draft regulations of the DNP, the proposed projects will require the implementation of Environmental Impact Assessment (EIA) and the development of Environmental Management Plan (EMP). In addition to the biodiversity significance of the proposed project areas within the framework of the DNP Draft Regulations, recommendations of the previous studies undertaken and covering the Kuiseb Delta and Dune Belt Areas such the Strategic Environmental Assessment (SEA) for the coastal zone of the Erongo Region recommended undertaking EIAs and development of EMPs for new projects that are likely to have significant negative impacts on the environment.

The project activities proposed for the Kuiseb Delta and Dune Belt areas falls within the listed activities that requires environmental assessments to be undertaken in line with the provisions of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007). In accordance with the provisions of the Environmental Management Act, 2007, (Act No. 7 of 2007), Part I - Definitions and Object of Act, the term “environment” means the complex of natural and anthropogenic factors and elements that are mutually interrelated and affect the ecological equilibrium and the quality of life.

4. Environmental Assessment Process

Environmental Assessment (EA) process covering Scoping, Environmental Impact Assessment (EIA) and the development of an Environmental Management Plan (EMP) in Namibia is governed by the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 gazetted under the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) in line with the provisions of the Cabinet approved Environmental Assessment Policy for Sustainable Development and Environmental Conservation of 1995 published by the Ministry of Environment and Tourism. Detailed assessments of any likely short and long-term positive and negative impacts of the proposed projects activities are contained in this Environmental Impact Assessment (EIA) Vol. 2 of 3 with the management and mitigation measures described in the Environmental Management Plan (EMP) Vol. 3 of 3 (EMP) report. The implementation of the EA process for the proposed projects activities have been undertaken in accordance with the provisions of the regulations and associated policies.

The methodologies and data synthesis were based on a set of interactive knowledge from a variety of sources covering the proposed project area. The knowledge that has been created and used at different stages of the assessment comprised climatic, environmental and ground components of the natural environment. The climatic components that have been used are precipitation, temperature, evapotranspiration and wind data. The environmental components comprised the type of proposed and existing activities, local ecological setting such as fauna, flora and habitats, archaeological setting, socioeconomic and community settings. The ground components cover the regional and local geology, geomorphology, surface water and groundwater as well as local landscape structures. The data synthesis process utilised the Vulnerability Mapping Techniques (VMTs) in developing the five (5)

Decision Support Tools (DSTs) in form of Thematic Maps (TMs) covering the proposed projects areas of the Kuiseb Delta and Dune Belt.

Consultation and engagement of stakeholders also called Interested and Affected Parties (I & APs) has been part of the EIA process for this project. Advertisements were placed in the local Newspaper while telephones, faxes, letters and emails were part of the communication and outreach programme linked to a number of meetings and workshops programme.

5. Regulatory Compliance

Constitution of the Republic of Namibia, 1990 has a clear relevance to environmental management associated with the proposed project activities in Kuiseb and Dune Belt Areas as outlined in Article 95: *Promotion of the Welfare of the People. This affirms that the State shall actively promote and maintain the welfare of the people by adopting policies aimed at the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future*.

Important legislative instruments that affect the prefeasibility, feasibility, development, operation of the proposed project activities in the Kuiseb and Dune Belt Areas include the following:

- Environmental Management Act No. 7 of 2007- Implemented in February 2012 through the gazetting of the Environmental Impact Assessment Regulations No. 30 of 2012 published by the Ministry of Environment and Tourism;
- National Heritage Act 27 of 2004 - Ministry of Youth, National Service, Sport and Culture;
- Nature Conservation Ordinance, No. 4 of 1975 - Ministry of Environment and Tourism (MET);
- Water Act 54 of 1956 - Minister of Agriculture, Water and Forestry;
- The Labour Act, 2007 (Act No. 11 of 2007) - Ministry of Labour;
- Atmospheric Pollution Prevention Ordinance 11 of 1976 - Ministry of Health and Social Services;
- Forest Act 12 of 2001 - Minister of Agriculture, Water and Forestry;
- Hazardous Substances Ordinance 14 of 1974 - Ministry of Health and Social Services;
- Public Health Act 36 of 1919 - Ministry of Health and Social Services;
- Regional Councils Act, 1992, (Act 22 of 1992);
- Local Authorities Act, 1992, (Act 23 of 1992);
- Regional Agreements:
    - ✓ Southern African Development Community: Protocol on Mining; and

- ✓ Southern African Development Community: Protocol on Energy

- Other legal instruments to be identified during the full EIA study.

6. Natural Environment

6.1 Overview

The natural Kuiseb Delta and Dune Belt areas comprise a diverse landscapes ranging from Namib Desert Sand Seas, deltaic environment, marshland, ephemeral rives channels, gravel planes and rock heads outcrops. All these varieties of landscapes support a diverse numbers of flora and fauna. Overall, the area holds key environmental resources ranging from archaeological resources to key biodiversity and socioeconomic support systems.

6.2 Vertebrate Fauna Diversity

It is estimated that at least 54 reptile, 7 amphibian, 42 mammal and 182 bird species (breeding residents) are known to or expected to occur in the general area of which a large proportion are endemics. Endemics include at least 50% of the reptiles, 43% of the amphibians, 29% of the mammals and 4% (7 of the 14 Namibian endemics) of all the breeding and/or resident birds known and/or expected to occur in the general area. During the fieldwork conducted between 23 and 27 July 2011, 26 reptiles, 0 amphibians, 15 mammals and 82 bird species were identified and confirmed (See Appendix 1).

6.3 Flora Diversity

Between 26 and 39 species of larger trees and shrubs are known and/or expected to occur in the general area of which 6 species are classified as endemic (i.e. 15.4%) while up to 48 grasses – 6 to 37 species – occur in the general area. During the fieldwork, only 9 species of larger trees/shrubs (3 species protected by Forestry and 1 species being endemic – i.e. *Arthraerua leubnitziae*) and 8 species of grass (1 species being endemic – i.e. *Stipagrostis sabulicolia*) were confirmed from the general area.

Important flora species in the general area are the lichen fields and specific species – e.g. endemics (*Arthraerua leubnitziae* etc.) and economically important species such as *Acanthosicyos horridus*. *Acanthosicyos horridus* (!Nara) is endemic to the dunes of the Namib Desert and are important as a source of food to the Topnaar community living in the Kuiseb River area. It also serves as habitat to a variety of desert vertebrates and invertebrates (Seely 2010) and even serves as a nesting site for the Southern Pale-chanting Goshawk in areas devoid of larger trees/shrubs (N. Dreyer *Pers. com.*). Destruction and/or unscrupulous harvesting thereof would pose a threat to these plants and associated fauna.

The lichen fields are difficult to protect although some areas have been fenced off for better protection over the last few years. The overall diversity of lichens is poorly known from Namibia, especially the coastal areas and statistics on endemicity is even sparser (Craven 1998). More than 100 species are expected to occur in the Namib Desert with the majority being uniquely related to the coastal fog belt. Lichen diversity is related to air humidity and generally decreases inland from the Namibian coast (Schults and Rambold 2007). Off road driving is the biggest threat to these lichens which are often rare and unique to Namibia. Another importance of the lichens is that the endemic Damara Tern often uses these fields as a breeding ground (Craven and Marais 1986). To indicate how poorly known lichens are from Namibia, the recent publication by Schultz *et al.* (2009) indicating that 37 of the 39

lichen species collected during BIOTO surveys in the early/mid 2000's were new to science (i.e. new species), is a case in point.

Often deserts and plants associated with this marginal area look "dead" although are not, and thus not viewed as important. All desert vegetation serves as a source of habitat for desert dwelling fauna – e.g. arthropods and reptiles. All development have potential negative environmental consequences, but identifying the most important flora species including high risk habitats beforehand, coupled with environmentally acceptable mitigating factors, lessens the overall impact of such development

6.4 Habitats, Flora and Fauna Sensitive Areas

The entire area varies in sensitivity from the globally important Sandwich Harbour wetland in the south to the largely disturbed gravel plains north of the Kuiseb River and the largely sparsely vegetated sand dune system dominating the central areas to the lichen rich gravel plains in the north bordering the Swakop River. The actual dune belt area between Walvis Bay and Swakopmund is viewed as more resilient than many of the other habitats in the area. The leeward side of the dunes are viewed as more important as windblown detritus collects here luring a variety of detritus feeding wildlife. All vegetated patches within this dune belt system would be viewed as important habitat as this serves as habitat to a variety of vertebrate fauna. The overall area is well protected with the Kuiseb delta and dune belt area, with the exception of the Walvis Bay and Swakopmund town lands, formally protected within the recently proclaimed Dorob National Park. The Sandwich Harbour area furthermore falls within the Namib-Naukluft Park. According to the Uranium Rush Strategic Environmental Assessment undertaken by the Ministry of Mines and Energy (MME) in 2010 covering the entire central coastal area, the following general sensitive areas were identified:

(i) Biodiversity red flag areas:

- ✓ Coastal area immediately north of Walvis Bay (e.g. Important bird areas; high density of waders along beach; Damara Tern breeding areas);
- ✓ Walvis Bay Lagoon (e.g. Internationally recognised RAMSAR wetland and Important Birding Area);
- ✓ Kuiseb Delta (e.g. very high density of !Nara plants; important for Topnaar livelihoods)
- ✓ Sandwich Harbour (e.g. internationally recognised RAMSAR wetland and Important Birding Area).

(ii) Biodiversity yellow flag area:

- ✓ Inland Gravel Plains (e.g. Lichens, invertebrates and biodiversity associated with Tumas drainage area. Tumas 'mouth' – reedbed and ephemeral spring on eastern edge of dunes, hummocks and ephemeral wetland).

6.5 Archaeology

The !Khuiseb Delta is a complex landscape of mobile dunes and relict silt beds on the outskirts of Walvis Bay. It was here that regular contacts were first established between the ‡Aonin , or Topnaar, and visiting European ships, more than a century before the imposition of colonial rule. Now, well preserved archaeological evidence reflecting this early phase Namibia's history is under threat from encroaching development and uncontrolled tourism.

The proposed project activities such as the proposed lodge directly falls in areas of key archaeological resources. The following is the summary principal recommendations with respect to proposed project activities and archaeological resources sensitivity and mitigation management measures:

- The core archaeological zone of the !Khuiseb Delta should be proclaimed as a Conservation Area in terms of Section 54 of the National Heritage Act (27 of 2004);

- Tourism (both commercial and community-based) should be strictly controlled, with visitor access to sensitive archaeological areas explicitly prohibited;

- Tourist camps, facilities, walking trails and routes of vehicle access should be excluded from sensitive archaeological areas;

- A cultural, historical and environmental information centre should be established as a visitor gateway for access to the delta under the supervision of trained guides;

- Continued archaeological survey of the !Khuiseb Delta should be integrated with approved tourism ventures and training initiatives.

6.6 Socioeconomic

The socioeconomic environment of the study area is highly skewed if one compares the urban centres of Walvis Bay and Swakopmund to that of the indigenous Topnaars. Locally, the Topnaars have become a significant part of cultural tourism in Namibia for their donkey carts and cultural performances within the study area. A number of operators include visits to the Topnaars in their itineraries. The importance of mining in the region, as well as its relatively high level of industrialisation, and the recent increases in tourism, has attracted a large number of migrant labourers to the region. The fact that only 40% of Erongo's population was born in Erongo is testament to this (NPC 2007, Census data of 2001). Similarly Erongo differs from most other regions in Namibia in that its population is highly urbanised (80% of the people live in urban areas with the remaining 20% in rural areas). Erongo also typically fares better than other regions in terms of variables such as income, employment, health and education. However considerable social problems exist in the region.

The main economic activities in the Erongo Region are concentrated in the two coastal towns of Walvis Bay and Swakopmund, as well as at the mining sites of Rössing, Langer Heinrich and adjacent to Karibib. The smaller towns generally offer limited chances of employment, while opportunities in agriculture, small-scale mining and tourism vary widely throughout the region. According to the 2001 Census Indicators, about 67% or residents employments in forms of wages and salaries followed by 10% for pensioners and business and cash remittances makes up the 16% respectively. There are only 4% of residents who are farming.

6.7 Ground Components

The proposed project areas covering the Kuiseb Delta and Dune Belt Areas comprise varying landscape with the topographic higher areas dominated by the dune belt zones while the topographic low areas are defined by the ephemeral rivers such as the Kuiseb and all its tributaries and delta. The study area covering the proposed projects sites is dominated by landforms of aeolian, denudation, fluvial-deltaic and marine. As such, they inter-finger and form complex terrain units attributed to more than one geomorphological agents. By virtue of

the geographic and climatic condition of the area, aeolian landform makes up the largest portion of the study area, constituting approximately 60%. Denudational landforms are distant second at 21% of the study area. Terrains units are discussed below in details under the heading of main geomorphological processes, namely, aeolian, denudation, fluvio-deltaic and marine, that acted in their formation.

7. Impact Assessment

The impacts of tourism activities on the environment were evaluated in terms of nature of impact (identification), magnitude, extent, duration and significance as outlined in the Table 1. The impacts identified could be positive or negative. The overall likely impacts of the proposed construction, operation and development of tourism activities in the study area are outlined in Table 2. The assessment table also applies to identified and existing tourism operations in the study area.

Table 1: Criteria used to evaluate impacts.

Criteria	Categories
Nature of Impact	Description of the effect of a proposed/existing activity on the environment. - Positive - Negative - Direct - Indirect - Cumulative - Synergistic
Magnitude	- Severe - Moderate - Low
Extent	- International - National - Regional - Local
Duration	- Short term - Long term - Project Life Span - Permanent
Significance	- High - Medium - Low

Table 2: Synthesis table of all potential impacts.

Description and Nature of Impact	Magnitude	Extent	Duration	Significance
Uncontrolled tourism and Unrestricted access NEGATIVE, DIRECT	Severe	Region & Local	The duration of the impact is expected to be short to medium term if mitigated	Before mitigation: **High** After mitigation: **Medium** to **Low**
Commercial activities and Urban development NEGATIVE, SYNERGISTIC	Severe	Local	Permanent if no mitigation	Before mitigation: **Medium** After mitigation: **Low**
National Park and Concession area's activities NEGATIVE, DIRECT AND SYNERGISTIC	Severe	Region & Local	Permanent to Long-term if not mitigated	Before mitigation: **High** After mitigation: **Medium** to **Low**
Placing of settlements, structures and facilities in highly sensitive archaeological areas NEGATIVE, DIRECT	Severe	Local	Permanent	Before mitigation: **High** After mitigation: **Medium** to **Low**
Faunal loss and disturbance NEGATIVE, CUMULATIVE	Severe to Moderate	Local	The duration of the impact is expected to be permanent over most of the proposed development sites once established. Most species (e.g. various birds and smaller mammals) are expected to re-colonise the area after completion of the development(s) – i.e. duration viewed as short to medium term – while other species are not expected to return (e.g. various secretive carnivores) – i.e. duration viewed as long term. This however, would be a relatively small area with localised implications.	Before mitigation: **High** After mitigation: **Medium** to **Low**
Floral loss and disturbance NEGATIVE, CUMULATIVE	Severe to Moderate	Local	The duration of the impact is expected to be permanent over most of the proposed development sites once established. Most species, especially annuals, are expected to re-colonise the area after completion of the development(s) – i.e. duration viewed as short to medium term – while the destruction of mature trees are not expected to rebound soon – i.e. duration viewed as long term. This however, would be a relatively small area with localised implications.	Before mitigation: **High** After mitigation: **Medium** to **Low**

Table 2: *Cont.*

Description and Nature of Impact	Magnitude	Extent	Duration	Significance
Sensitive areas in the Kuiseb and Dune Belt area NEGATIVE, CUMULATIVE	Biodiversity sensitive areas: **Severe** -Coastal area immediately north of Walvis Bay -Walvis Bay Lagoon -Kuiseb Delta -Sandwich Harbour **MODERATE to LOW** Inland Gravel Plains	International, Regional, National & Local	Permanent to long-term if not mitigated	Before mitigation: **High** After mitigation: **Medium** to **Low**
Socioeconomic POSITIVE, DIRECT AND INDIRECT	Severe	Local	Permanent to long-term	Before mitigation: **Medium to Low** After mitigation: **High**
Visual impacts NEGATIVE	Low	Local	Permanent	Before mitigation: **Medium** After mitigation: **Low**
Water use and quality NEGATIVE (unmitigated), POSITIVE (sustainable utilisation and management) DIRECT	Moderate	Local	The duration of this impact could last the entire project life span	Before mitigation: **Medium** After mitigation: **Low**
Waste and Sewage management at project sites POSITIVE (mitigation)	Moderate	Local	The duration of this impact could last the entire project life span	Before mitigation: **Medium** After mitigation: **Low**
Dune morphology and Wind situation NEGATIVE, INDIRECT	Moderate to low	Local	Short term and seasonal	Before mitigation: **High** After mitigation: **Medium to Low**
Cumulative Impacts NEGATIVE, CUMULATIVE	Severe to Moderate	National, Regional & Local	The cumulative impacts could last the entire project life span	Before mitigation: **Medium to high** After mitigation: **Low**

8. Development Opportunities

Based on all the data collected and analysed at different stages of this EIA study process, including all the findings and recommendations of the specialist studies, all the results and recommendations have been evaluated and interpreted. Although the proposed projects will have very high positive socioeconomic impacts, based on the extent, duration and intensity of both likely negative and positive impacts of the proposed projects development for both the Kuiseb Delta and the Dune Belt areas will have high negative impacts on the local environment. Environmental Management Plan (EMP) Report Vol. 3 of 3 incorporating all the constraints, relevant mitigation measures with respect to likely impacts and recommendations has been prepared for implementation by the developer / operator. The EMP implementation and monitoring activities covers all the stages of the proposed projects life cycle and is inclusive of the preconstruction, development, construction, operational stages.

9. EIA Conclusions and Recommendations

The Environmental Impact Assessment study discovered that there are severe to moderate impacts on the natural environment as well as the cultural heritage of the area. The ongoing tourism activities and proposed community-based tourism activities in the Kuiseb Delta and Dune Belt Area might have negative direct and indirect impacts on the environment. The degree of confidence in predictions of these impacts is very high as specialists studies indicated. The potential threats identified in this study could be mitigated if conservation and preservation measures are adopted first before the implementation of the proposed development. The ongoing tourism activities continue to improve the socioeconomic status of entrepreneurs around Walvis Bay and Swakopmund area. Tourism ventures from other parts of the countries also benefit from this area. The Kuiseb Delta Concession and Project as well as the proposed bird watching paradise will significantly alleviate poverty and unemployment among Topnaars community along the Kuiseb Delta.

On the other hand, the Kuiseb Delta project proposal is uninformed as to the archaeological value of the area and has used archaeological survey data merely as an aid to identifying the most commercially advantageous position for the project. The project is a community-based enterprise, but its formulation is no different from that of commercial tourism projects that fail to consider the potential impact of their activities. In this way, the Kuiseb Delta Development Project proposal represents a “worst case” scenario for the management and conservation of this archaeological landscape. The fact that it is supported by organizations such as NACOMA and evidently the Ministry of Environment, without the National Heritage Council demanding better controls, merely illustrates the institutional threats that are posed to the archaeological record in Namibia. The study therefore recommends that the proposed projects and concession should not go ahead in its present form and must only be approved subject to the following suggestions:

- ✓ Proclaim the archaeologically significant part of the Kuiseb Delta as a Conservation Area under the National Heritage Act;
- ✓ Appropriate buffers must be created to separate current and future projects activities areas from key environmental sources such as the Kuiseb Delta archaeological sites, key avian breading zones of the Dune Belt Areas as well as other important habitats and conservation zones / corridors;
- ✓ Any access to archaeological sites should be strictly monitored and subject to specific guidelines as to routes, group numbers and other factors;

- ✓ No settlements, camping or other overnight facilities should be permitted in any area designated as archaeologically sensitive;

- ✓ Avoid all development in the areas viewed as sensitive habitats – i.e. Sandwich Harbour, lichen fields, Kuiseb and Tumas Rivers, rocky outcrops, Caution Reef, Horses Graves and Paaltjies *Salsola* dune hummocks;

- ✓ Implement and maintain track discipline limited to existing tracks and/or certain tracks with maximum speed limits (e.g. 30km/h) as this would result in fewer faunal road mortalities and associated dust pollution problems;

- ✓ Avoid off road driving in areas prone to scarring and especially the lichen fields. Nocturnal driving should also be avoided as this result in the destruction of slow moving fauna – e.g. various reptiles and other nocturnal species;

- ✓ Avoid the removal and damage of bigger trees (especially protected species – i.e. *Acacia erioloba*, *Faidherbia albida* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952) – during developments – including the development of access routes – as these serve as habitat for a myriad of fauna. This is relevant to developments in the Kuiseb River area;

- ✓ The environmental management and monitoring of the dune belt area, the free off-road vehicle zone and the Kuiseb delta should form part of the Dorob National Park management.

It is hereby recommended that the proposed projects may only go ahead on condition that the proposed multiple land use approach (proposed and current activities, conservation and tourism opportunities) are all fully incorporated and integrated in the high need for archaeological resources conservation with appropriate buffers enforced in line with the specialist studies recommendations and in line with the Dorob National Park Regulations. In terms of the management of any likely short and long-term positive and negative impacts likely to be associated with the proposed developments for both the Kuiseb and Dune Belt areas, it's hereby recommended that an Environmental Management Plan Vol. 3 of 3 (EMP) Report must be developed for implementation by the proposed project developers for both the Kuiseb Delta and Dune Belt Areas covered in this EIA study.

1. BACKGROUND

1.1 Introduction

The proposed projects development described and assessed in this Environmental Impact Assessment (EIA) Vol. 2 of 3 are supported by the Namibian Coast Conservation and Management Project (NACOMA). The NACOMA Project is a five (5) year project that was officially launched in March 2006. NACOMA is funded by the Global Environmental Facility (GEF) and co-funded by the Government of the Republic of Namibia (GRN). It is being implemented by the GRN (through National Planning Commission) and the World Bank on behalf of GEF.

The NACOMA project is part of the GRN's strategy to promote sustainable economic development in the coastal zone and address its local, regional, national and global environmental responsibilities. The project is designed to run parallel with Namibia's decentralisation process, which aims to transfer more responsibility and authority to the Regional Councils and Local Authorities. Under the NACOMA Project Sub-component 3.2., "Implementation of Priority Actions under the Management Plans at site and landscape level", the NACOMA Project provides support for small Matching Grants (MGs) for targeted investments in specific project intervention sites (ecosystems of biodiversity importance).

The Kuiseb Delta Community and investors from Walvis Bay and Swakopmund were awarded small MGs to invest in projects that support sustainable development. It is against this background that NACOMA commissioned this study on behalf of the applicants (Proponents) to conduct an Environmental Assessment (EA) covering Scoping (Vol. 1 of 3), this Environmental Impact Assessment (EIA) Vol. 2 of 3 report and develop an Environmental Management Plan (EMP) Vol. 3 of 3 report. The overall aim of the study is to reconfirm the carrying capacity of the Kuiseb Delta to community based tourism and Dune Belt Area to various conflicting resource use activities. The following is the summary of the proposed development activities covered in this EIA report:

(i) The Kuiseb Delta Development Trust applied for a concession from the Ministry of Environment and Tourism (MET) and engages in Community Based Tourism activities. The Kuiseb Delta Development Trust is the proponent for this project in line with the provisions of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007);

(ii) The Walvis Bay Bird Paradise proposes to establish a bird watching tourism activity. The Walvis Bay Bird Paradise is the proponent for this project in line with the provisions of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007);

There are also other already existing activities in the area, such as quad-biking, cultural, sightseeing and eco-tours operating in the proposed projects and the surrounding areas. The nature and coverage of the existing and proposed activities and their likely negative impacts on the sensitive coastal environment resulted in the proposed EA study area being extended beyond the proposed projects areas to include the Dune Belt, lower Kuiseb River and Delta Area. Within the framework of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007), all existing listed activities currently taking place within the study areas will be required to

obtained Environmental Clearance Certificate as may be determined by the Environmental Commissioner.

1.2 Environmental Assessment Requirements

In accordance with the provisions of the Environmental Management Act, 2007, (Act No. 7 of 2007), Part I - Definitions and Object of Act, the term "environment" means the complex of natural and anthropogenic factors and elements that are mutually interrelated and affect the ecological equilibrium and the quality of life, including:

(a) The natural environment that is the land, water and air, all organic and inorganic material and all living organisms; and

(b) The human environment that is the landscape and natural, cultural, historical, aesthetic, economic and social heritage and values.

The usage of the term environment for this proposed project thus encompasses all aspect / components of the environment as provided for in the Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995) and the Environmental Management Act, 2007, (Act No. 7 of 2007).

In accordance with the provisions of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007), the proposed projects activities for both the Kuiseb Delta and Dune Belt areas are subject to Environmental Assessment (EA). The EA requirements for the proposed projects cover Scoping, EIA and EMP. In demonstration of the highest commitment to good environmental management as well as in meeting national environmental regulatory as well as operational requirements, the NACOMA Project appointed University Central Consultancy Bureau (UCCB) the consulting arm of the University of Namibia (UNAM) as the environmental consultants for the proposed project. A number of specialists were contracted to undertake and manage the environmental assessment process.

1.3 Specialist Team

The following is the summary of the specialist grouping that has been involved in the EA process covering Scoping (Vol. 1 of 3), EIA (Vol. 2 of 3) and EMP (Vol. 3 of 3) study stages:

- ✓ Dr. Sindila Mwiya (Environmental Assessment Practitioner (EAP) (Risk-Based Solutions (RBS) Consulting Arm Foresight Group Namibia (FGN) (PTY) LTD);
- ✓ UNAM / UCCB Specialist Team – (Ms. Margaret Angula, Dr. Martin Hipondoka and Ms. Ngula Niipele;
- ✓ Peter Cunningham Specialist Consultant Flora and Fauna (Environment & Wildlife Consulting Namibia), and;
- ✓ Dr J. Kinahan, Specilsist Consultant Archaeology T/A QRS Namibia.

The detailed roles and responsibilities played by each of the above specialists are described in Table 1.1.

Table 1.1: Detailed roles and responsibilities of the specialist teams.

Team Member	Position	Task Assigned
Dr Sindila Mwiya	EAP	• Develop the framework for conducting EIA in the Kuiseb Delta and Dune Belt. • Finalize and Edit EIA & EMP reports
Dr Martin Hipondoka	GIS/RS & Geomorphology expertise	• Map the Kuiseb Delta and Dune Belt Area • Digitization of ecologically sensitive areas/zones.
Dr John Kinahan	Archaeology Expertise	• Prepare an authoritative baseline document focusing on the assessments of key archaeological sites • Evaluate the impact of current tourism activities on the archaeological sites • Set out site management and conservation proposals • GIS mapping of the archaeological landscape • Demarcate a proposed area for proclamation under the National Heritage Act (27 of 2004) as a Conservation Area,
Mr Peter Cunningham	Vertebrate Fauna and Flora Expertise	• A comprehensive literature review vertebrate fauna & flora known or expected to occur in the general areas. • Assess the bio-physical (vertebrate fauna & flora) issues relevant to the above mentioned areas. • Assess the significance of development and environmental impact that such developments may have on the vertebrate fauna & flora at the proposed development site(s) including general comments. • Finalize a Scoping Report & final report containing findings on the vertebrate fauna & flora known or expected to occur along the study areas.
Ms Margaret Angula	Team Leader EIA/SIA	• Maintain liaison with the client (NACOMA) and other related agencies; • Submit reports, • Co-ordinate and integrate the activities of the multidisciplinary team members; • Participate in the public consultation sessions and attend meeting as and when required by the client • (NACOMA).
Ms Ngula Niipele	Assistant Team leader/ GIS expertise	• Map the Kuiseb Delta and Dune Belt Area • Digitization of ecologically • sensitive areas/zones • Organize site visits/workshops • Coordinate functions of the team • Administer the project

1.4 Objectives of Environmental Assessment Process

The main objective of the EIA study described in this report has been to evaluate the biophysical and socioeconomic settings as well as all aspects of the natural environment around covering the entire study area with respect to any likely negative and positives that may occur as a result of the proposed projects activities. Special focus in terms of specialist studies were undertaken on the local environmental settings such as the likely negative and positive socioeconomic impacts as well as habitats around Kuiseb Delta and Dune Belt Areas. Likely potential short and long-term impacts with respect to the proposed project were

carefully evaluated. The aim has been to collect, assess and document the likely temporal and long-term positive and negative environmental and socioeconomic impacts of the proposed project activities from preconstruction to operational stages.

The structure of this EIA Report covers both, legislative and the natural environment technical data sets, grouped into climatic, environmental and ground components with respect to the proposed projects. The climatic components cover the various regional and local data sets such as rainfall, temperature, evaporation and wind. Fauna, flora, archaeology as well as community issues, which include social, economic and political facets at international, national, regional and local levels, form a part of the environmental components of the natural environment. The ground components cover the regional and local water resources, geology, geomorphology, and hydrogeology, as well as geotechnical influences such as discontinuities characteristics. All these relevant data sets have been reviewed at the earliest stage of the project development.

The process steps that has been followed in the preparation of this Vol. 2 of 3 EIA Report took into considerations the provisions of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 under the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) and in line with the Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995) as well as the operational requirements of the NACOMA Project. These assessment process steps are summarised as follows:

(i) Prepared the Inception Report in line with the NACOMA Project operational and projects implementation requirements;

(ii) On approval of the Inception Report, prepared the Draft Environmental Scoping Report (Annex 1) including details of the proposed projects activities;

(iii) Submitted the Draft Scoping Report to the NACOMA Project. Following the approval by the NACOMA Project, communicated it to all interested and affected parties through an advertisement in the local newspapers, telephone, faxes, emails, meetings and workshops. The views and comments received formed part of the Term of Reference (ToR) for the full EIA study implemented in form of specialised studies included in this report;

(iv) Implemented the full EIA and undertook specialised studies, followed by the evaluation of the likely positive and negative impacts associated with the proposed project activities on the environment. The results of the assessment presented in a Draft EIA (Vol. 2 of 3) and EMP (Vol. 2 of 3);

(v) Present the Draft EIA Report (Vol. 2 of 3) and the EMP (Vol. 3 of 3) to the client (NACOMA Project), key interested stakeholders and the authorities for further comments and input;

(vi) Incorporated all comments received in the preparation of the Final EIA (Vol. 3 of 3) and EMP (Vol. 3 of 3) reports for the proposed Kuiseb Delta and Dune Belt Projects and submitted the reports to the client (NACOMA Project) and to the Ministry of Environment and Tourism for considerations with respect to the issue of an Environmental Clearance Certificates.

1.5 Study Area / Projects Location

The 746 km2 of the study area encompasses four generic landforms subdivided in at least 14 terrain units covering the Kuiseb Delta and Dune Belt areas situated in coastal zone of the Walvis Bay District in the Erongo Region (Fig. 1.1). The study area lies in the Central Namib Desert, between the Swoop River in the north and the sand dune belt in the south of the Kuiseb River (Fig. 1.2). The Kuiseb Delta lies in an area where the Kuiseb River flows down a steepened gradient onto the coastal flats (Plate 1.1). The boundaries and local setting of the study area as defined by NACOMA covered the south bank of the Swakop River (Plate 1.2), enclosing the dune belt in a narrow strip (Plate 1.3), widening to include the extinct northern flood area and the extant central flood area of the! Khuiseb Delta (Plate 1.1). Excluded from the project area are the saltworks (Plate 1.4), Pelican Point sandspit (Plate 1.5), the town of Walvis Bay (1.6), and the coastal strip west of the B2 Road (Plate 1.7) and south of the extinct Tumas River mouth.

Figure 1.1: Regional location of the study area covering the Kuiseb Delta and Dune Belt Areas.

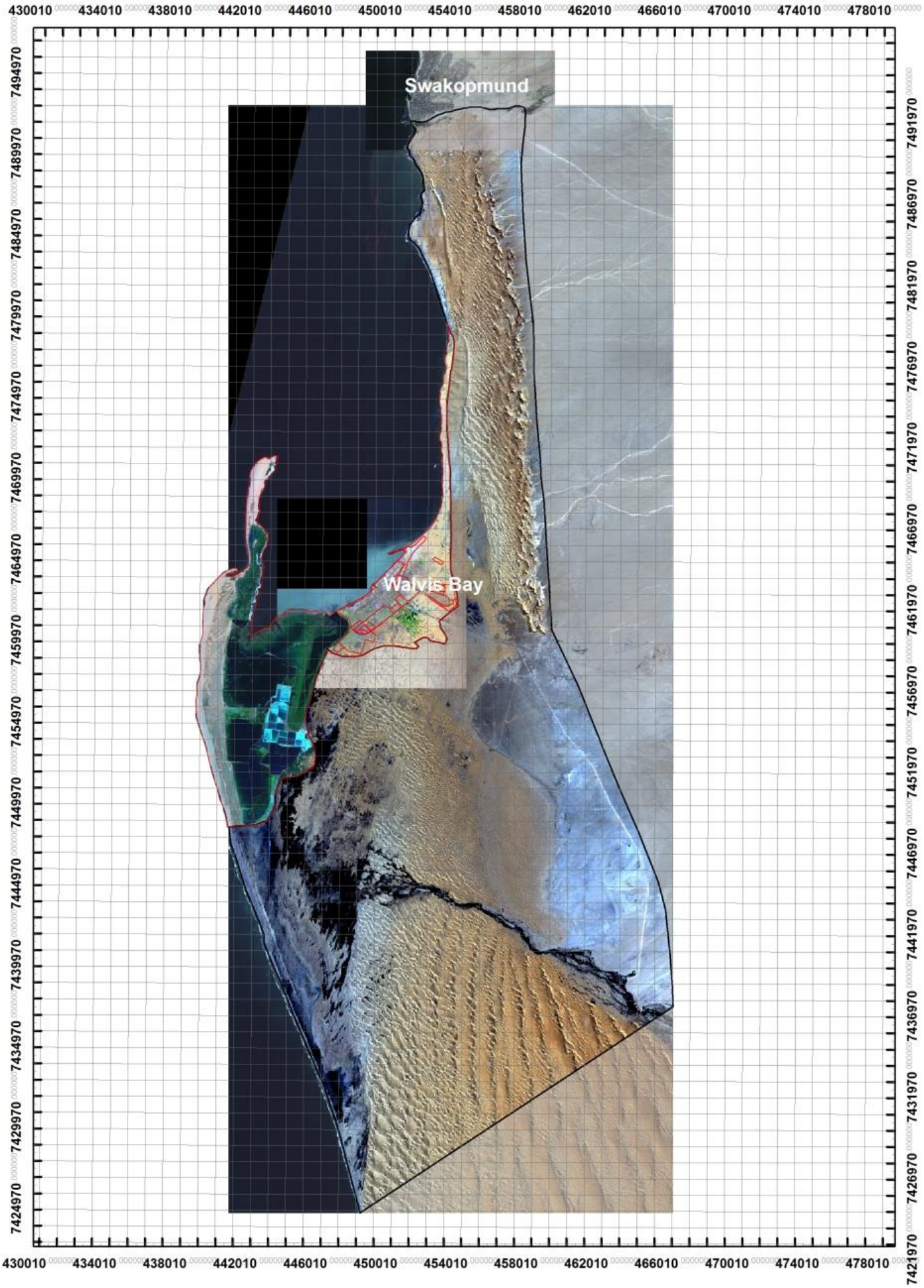


Figure 1.2: Detailed location of the study area covering the Kuiseb Delta and Dune Belt Areas.

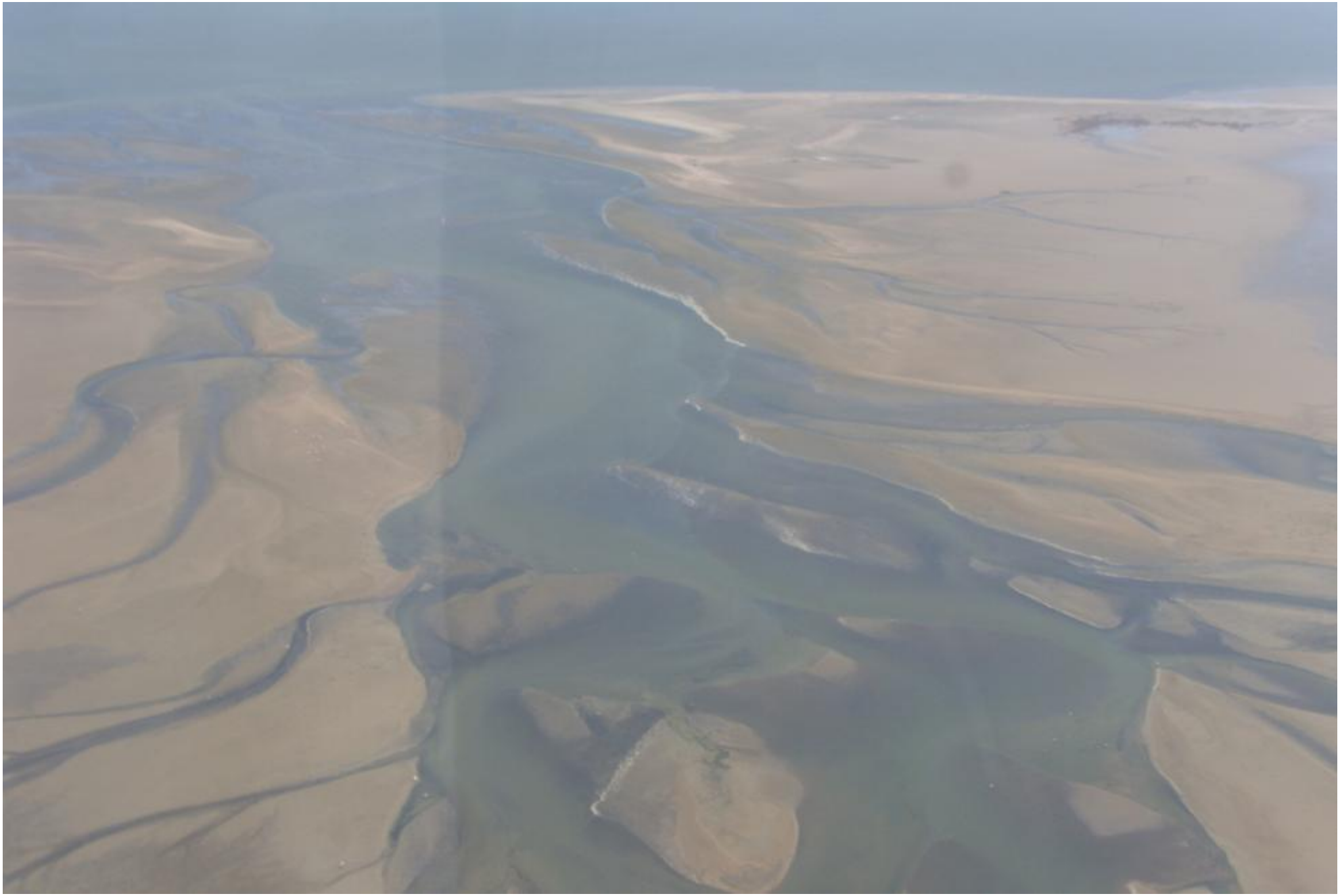


Plate 1.1: The Kuiseb Delta (RBS/ FGN Image Series, 2012).

Plate 1.2: The Swakop River, the northern boundary of the study area (Source: http://earthobservatory.nasa.gov/NaturalHazards - Accessed April 2012).

Plate 1.3: Dune Belt Area (RBS/ FGN Image Series, 2012).

Plate 1.4: Exclude salt works (RBS/ FGN Image Series, 2012).

Plate 1.5: Excluded pelican point (RBS/ FGN Image Series, 2012).

Plate 1.6: Excluded Walvis Bay Town (RBS/ FGN Image Series, 2012).

Plate 1.7: Excluded coastal strip west of the B2 western (RBS/ FGN Image Series, 2012).

2. NATIONAL AND LOCAL SERVICES AND INFRASTRUCTURE

2.1 National Overview

Services sector dominate Namibia's GDP and the main components are services provided by the public administration, real estate and business services, wholesale and retail trade (including repairs), transport and storage, financial intermediation. Namibia made minimal commitments on services under the World Trade Organization (WTO) General Agreement on Trade in Services (GATS). The country is committed to having no limitations on market access and national treatment for these services for all four modes of supply. It did not participate in the extended GATS negotiations on basic telecommunications (Fourth Protocol) or financial services (Fifth Protocol).

In terms of road and rail infrastructure, Namibia has an immense network of 64,800 kilometres of roads with 7,800 kilometres paved. A 4,600 kilometre tarred highway network links most of the economically-significant areas and neighbouring countries. The Trans Caprivi Highway and the Trans Kalahari Highway were 2 long-haul road projects completed in the late 1990s to run through Botswana to South Africa. These arteries which are part of the Walvis Bay Corridor Group enable Namibia to provide land-locked central African countries with an outlet to the sea, as well as reducing journey times to Johannesburg, South Africa (Plate 2.1). The Walvis Bay Corridor Group is a public-private partnership established to promote the utilisation of the Walvis Bay Corridors, which is a network of transport corridors principally comprising the Port of Walvis Bay, the Trans-Kalahari Corridor, the Trans-Caprivi Corridor, the Trans-Cunene Corridor, and the Trans-Oranje Corridor (Fig. 2.1). The country has a 2,382-kilometre railway network.

2.2 National Post and Telecommunications

The state-owned Telecom Namibia supplies basic services and the Mobile Telecommunications Company (MTC) and the privately owned Leo has a GSM network to provide cellular services. Telecom Namibia's performance contract with the Government specifies a 10% annual increase in telephone penetration. The Namibian Communications Commission is the sector's regulator, and the Ministry of Information and Communication Technology is the responsible Ministry. The Internet and other value-added services are open. There are five internet suppliers. The state-owned NamPost also provide courier services with over 100 post offices in Namibia. Post and telecommunication services will be readily available for the proposed project.

2.3 National Financial Services

Financial services are relatively well developed. Service providers include five commercial banks, the state-owned Agricultural Bank of Namibia, the Post Office Savings Bank, several merchant banks, and a range of non-bank financial institutions, such as insurance companies, pension funds, and money market funds. All commercial banks are privately owned, with substantial South African equity. One, the Standard Bank of Namibia, is 100% South African owned. South African, French, and German interests primarily own the Nedbank of Namibia. Namibian equity is mainly held in Bank Windhoek (56.4%). The First National Bank and the Standard Bank account for almost two thirds of the banking market. There are over 80 bank branches throughout the country. A capital market also operates around the Namibian Stock Exchange. Namibia is a member of the East and Southern Africa

Banking Group and it participates in the Committee of Central Bank Governors of SADC countries.

The Namibian insurance market is served by a number of private, mainly South African owned insurance companies, which offer a broad range of services. Two insurance companies, Sanlam and Old Mutual, de-mutualized in 1999. The state-owned Namibia National Reinsurance Corporation (NamibRe) was established in 1998 with capitalization of N$20 million. Insurance companies must re-insure with NamibRe. Pension and insurance funds must keep a minimum of 35% of their investments within Namibia.

2.4 National Transport Network

2.4.1 Overview

The transport subsector is dominated by the state-owned TransNamib Ltd. Rail transport services are offered through its subsidiary, TransNamib Rail. Transnamib is also a major supplier of road transport freight and passenger services through TransNamib Carriers. The transport subsector is relatively concentrated and dominated by a few operators, including state operators. The Department of Transport of the Ministry of Works and Transport is responsible for formulating and implementing transport policies.

The road infrastructure in Namibia is good with major network such as the Trans-Caprivi highway linking Namibia to the landlocked countries of Botswana, Zambia, and Zimbabwe and the Trans-Kalahari highway providing an important route between Walvis Bay and Botswana. Road transport consists of bus, taxi, and road haulage operators. There are about 200 road haulage operators using some 1,700 trucks and a freight capacity of around 31,000 tonnes. TransNamib Carriers is the largest operator. All other operators are private; four are relatively large. Operators must be registered with the Namibian Traffic Information System and have an operator's card. Commercial road carriers no longer require permits to carry certain goods. Permits are needed for cross-border transport. Freight rates are set privately. Namibia signed a bilateral Cross-Border Road Transport agreement with Zambia and Zimbabwe in 1999 to facilitate movement of goods and passengers between the countries. A joint Route Management Committee meets bi-annually to discuss problems impeding movement of passengers and freight between these countries.

2.4.2 National Rail Services

The rail network is being expanded by the construction of a new line from Tsumeb to Oshikango via Ondangwa, and the line from Aus to Lüderitz is being re-opened to handle the additional freight passing through that port. The Namibian railway network is linked only with South Africa. The Government removed the reserved goods scheme whereby 14 major commodities were reserved for rail transport. Rail remains the major mode for transporting bulk goods. The National Transport Corporation Act No. 21 of 1997 regulates railway operations. Ownership of the rolling stock is vested in the Ministry of Works and Transport while the market sets freight rates.

2.4.3 National Port Facilities

Namibia has two major ports, the main one at Walvis Bay (Plate 2.2), and another at Lüderitz. Both are administered by the parastatal Namibian Ports Authority (NamPort). Both ports have undergone substantial modernization and upgrading, including dredging to deepen them. New container facilities at Walvis Bay, serviced mainly by weekly ships via

Cape Town and Durban, provide among the quickest turnaround times in Africa. Lüderitz is becoming particularly important for fishing and the offshore diamond industry. Cargo levels have increased substantially. Lüderitz handles about 200,000 tonnes annually and Walvis Bay some 2 million tonnes. Two companies, one fully owned and the other 50% owned by TansNamib, provide liner services. There are about five private freight forwarders. There are no controls on entry into shipping or cabotage restrictions. Foreign vessels may operate domestic services between Walvis Bay and Lüderitz without a permit, provided they meet sea worthiness requirements and customs and immigration regulations.

2.4.4 National Air Services

Air Namibia provides scheduled domestic services and international flights to Germany. A number of international airlines provide regular services to Windhoek under various bilateral agreements. Cabotage is prohibited. Most foreign carriers have third and fourth freedom traffic rights. COMAV is the only carrier to have negotiated fifth freedom rights. The Air Services Act of 1949 and the Aviation Act of 1962 were both amended in 1998. There are no restrictions on supply of domestic aviation services provided the prospective carrier meets the legislative requirements. The Airport Company Act of 1999 commercialized the eight major airports. There are three international airports: Hosea Kutako and Eros at Windhoek, and Ondangwa. The aerodrome network remains the responsibility of the Ministry of Works and Transport, including those under the Namibian Airports Company. It runs them on a commercial basis. The provision of airport services is normally outsourced to private contractors.

2.5 Local Infrastructure and Services

The proposed Kuiseb Delta and Dune Belt projects are both situated in areas with already existing major and minor access road linked to key national road network (Plate 2.1). The nearest major Towns are Walvis Bay and Swakopmund. There is a full mobile service within the proposed project areas. The following is summary of the available local infrastructure and services that can support the development and operational stages of the proposed Kuiseb Delta and Dune Belt Projects:

(i) Infrastructure:

- ✓ Good road network (Plate 2.1);
- ✓ Supporting world class tourism accommodation;
- ✓ Good Walvis Bay international Airport with direct flights to Windhoek Cape Town and Johannesburg (Plate 2.2);

(ii) Services:

- ✓ Availability of all key supporting services in both Walvis and Swakopmund.

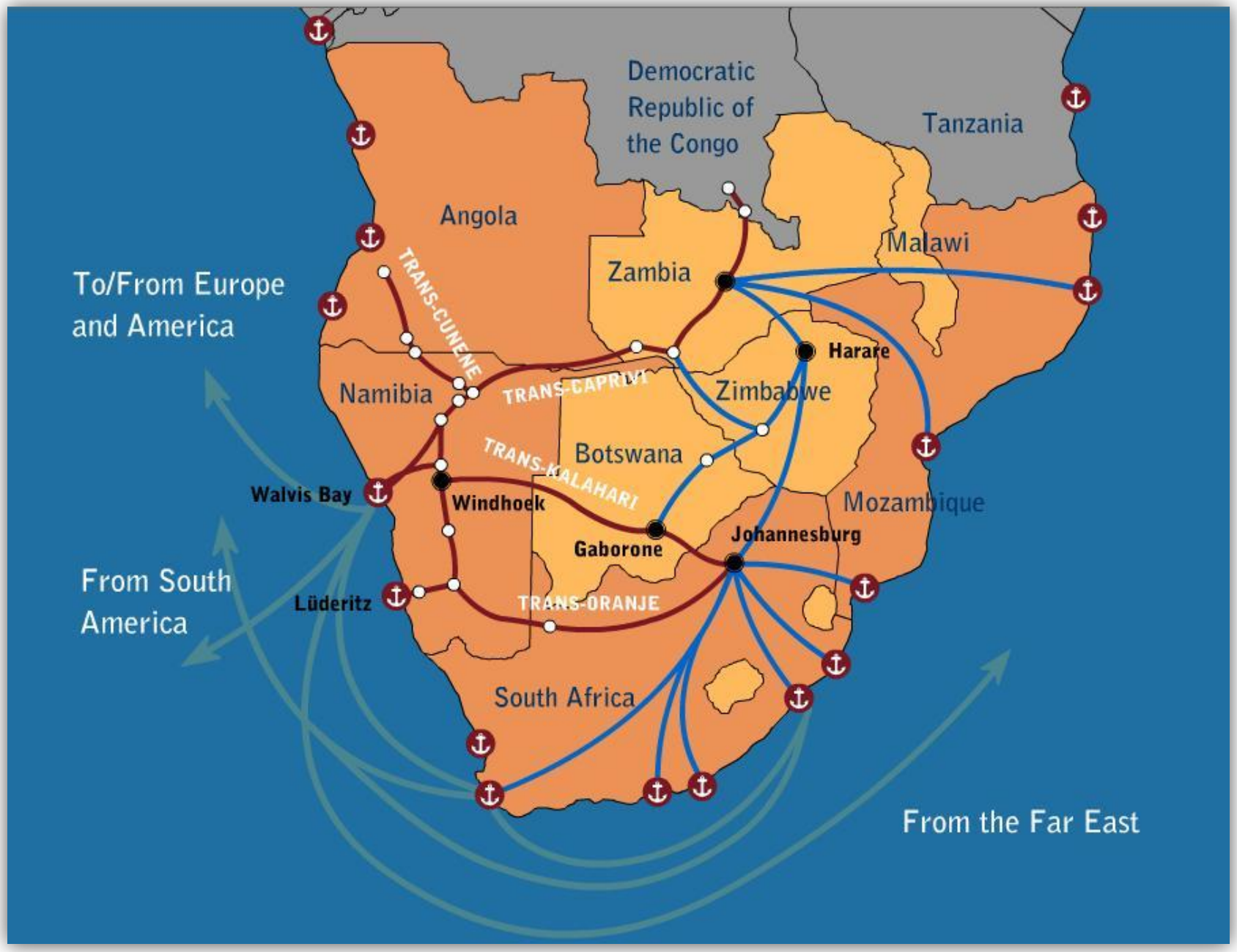


Figure 2.1: Walvis Bay Corridors (Source: www.wbcg.com.na – Accessed March 2012).

Plate 2.1: The B2 road linking the proposed site to the rest of World (RBS / FGN Image Series, 2012).

Plate 2.2: The Walvis Bay International Airport (RBS / FGN Image Series, 2012).

Plate 2.3: The Port of Walvis Bay (RBS / FGN Image Series, 2012).

2.6 Services for the Proposed Project

2.6.1 Electricity Supply Requirements

The likely limited electricity requirements for both the Kuiseb Delta and Dune Belt areas projects have not yet been established. Where required, electricity will be supplied by NamPower through the Erongo Red regional distributer. Renewable energy sources such as solar and wind will be more preferred for the proposed projects as they will not require a lot of electricity for daily operations. The already existing activities particularly around the Dune Belt Area such as the Quad Bike and other adventure tourism operator could also consider using renewable energy where applicable. During the construction and operational stages however, a diesel generator may be required as a backup power supply in order to keep critical construction or operational processes in case of a major power failure. The predicted average growth electricity demand is 3.5% per year. Table 2.1 presents the power demands under different scenarios mainly as the results on the ongoing mining rush in the Erongo Region. The Government of Namibia, through the Ministry of Mines and Energy and the implementing agent, NamPower, has been vigorously pursuing several power generation and transmission projects, to enhance and increase the current capacity.

According to the Strategic Environmental Assessment (SEA) conducted on the uranium rush in the Erongo Region, Namibia currently does not have appropriate infrastructure and existing sources and to meet the demands (MME, 2010). NamPower is investigating possibilities and alternatives to insure infrastructure is developed for future power demand. The power supply transmission network to the coast consists of a 220 kV transmission line, connecting the Omburo (at Omaruru) Substation via the Khan and Rössing Substations to Walmund Substation near Swakopmund (MME 2010). A ring system was created after the construction of the Van Eck –Kuiseb – Walmund 220 kV line in 2003. However, with the envisaged power demands from the uranium mines, NamPower is considering the necessity to reinforce this ring to be able to provide a stable and assured power supply to the mines. NamPower is thus considering a new line from the Khan Substation near Usakos via Valencia and Rössing South, to the Kuiseb Substation (Fig. 2.2).

Table 2.1: Predicted future power demands from uranium mines, related industry and urban growth Source (MME 2010).

Scenario	Power Demand for Mines (MW)	Power Demand: Related Industry and Urban growth (MW)	Total Demand (MW)
Scenario 1	120	55	175
Scenario 2	231	102	333
Scenario 3	278	102	380

2.6.2 Fuel Supply Requirements

Fuel and other related products required for the development and operation of the proposed projects for the Kuiseb Delta and Dune Belt Area are available in Walvis Bay and Swakopmund Towns. Where required, an onsite small fuel supply services may be installed for the Kuiseb Delta Project in order to support the project activities.

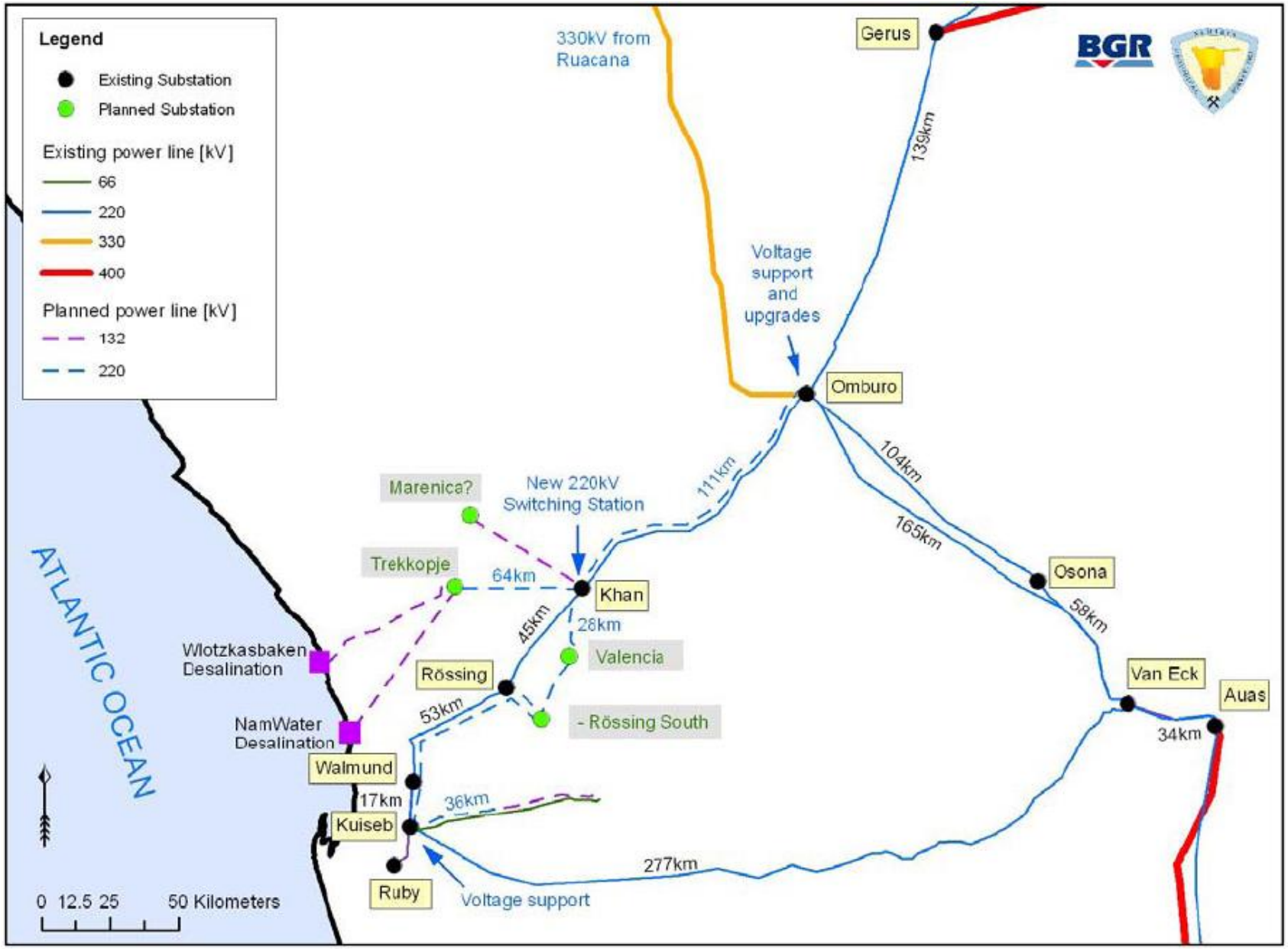


Figure 2.2: Proposed power transmission network in the Erongo Region (Source MME, 2010).

2.6.3 Water Supply Requirements

The Walvis Bay Municipality will supply the limited portable water requirements for the proposed projects. The limited freshwater requirements will be for human consumption only. A small tank will be created onsite to store some water for human consumption where required.

3. EIA ASSESSMENT METHODOLOGY

3.1 Namibia Environmental Assessment Procedure

The Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 under the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) and inline Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995) requires the following steps in an Environmental Assessment Procedure (Fig. 3.1) as used in the Scoping, EIA and EMP stages of the Environmental Assessment processes for the Kuiseb Delta and Dune Belt areas projects:

- Submission of Policy, Programme or Project;
- Registration of the Project with the Directorate of Environmental Affairs (DEA), Ministry of Environment and Tourism (MET);
- Development of Proposal;
- Classification of Proposal;
- Environmental Assessment;
- No Formal Assessment (should it be unlikely that the policy, programme or project will result in significant impacts);
- Review;
- Conditions and Approval;
- Record of Decision;
- Appeal;
- Implementation of Proposal;
- Monitoring; and
- Audits.

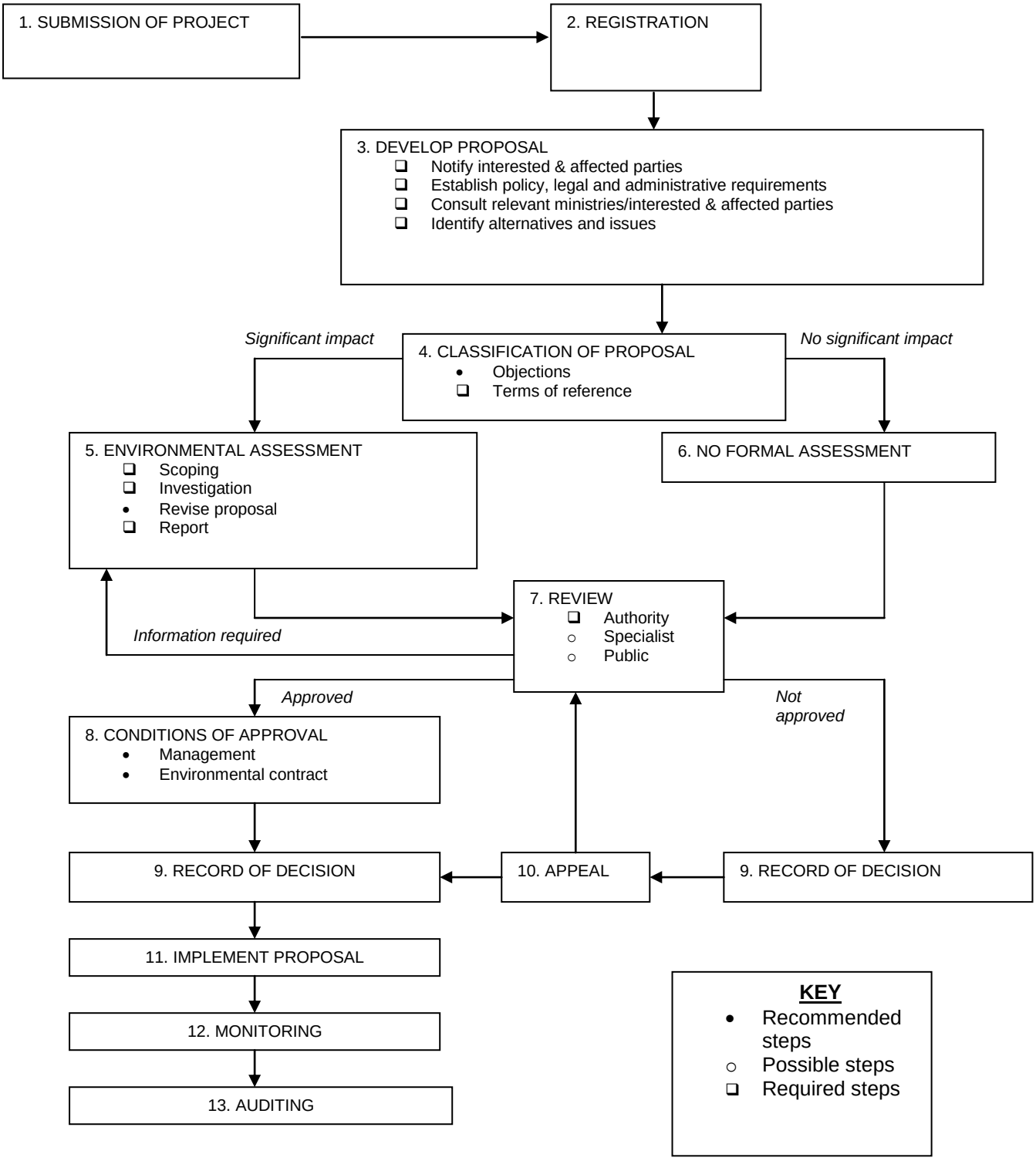


Figure 3.1: Schematic presentation of Namibia's Environmental Assessment Procedure.

The following Twelve (12) principles of environmental management as outlined in Part II, Section 3 of the Environmental Management Act (EMA), 2007 (Act No. 7 of 2007), were applied to the environmental assessment process for the proposed Kuiseb Delta and Dune Belt area projects:

- Use renewable resources on a sustainable basis for the benefit of present and future generations;

- Involve the community in natural resources management and promote and facilitate the sharing of benefits from the use of resources;

- Promote public participation in decisions affecting the environment and ensure that their interests, needs and values are taken into account;

- Promote equitable access to all environmental resources and consider the functional integrity of ecological systems so that the sustainability of systems is ensured and that harmful effects are prevented;

- Undertake environmental assessments for all projects that may adversely impact on the environment, or the use of natural resources;

- Promote sustainable development in all aspects relating to the environment;

- Protect and respect Namibia's cultural and natural heritage, including its biological diversity, for the benefit of present and future generations;

- Reduce the generation of waste and polluting substances at source by adopting the option that provides the most benefit or causes the least environmental damage, at costs acceptable by society, in the short- and long term;

- Promote the reduction, re-use and recycling of waste;

- Adopt the "polluter pays principle";

- In cases where there is sufficient evidence to conclude that there are threats of serious or irreversible damage to the environment, the lack of full scientific certainty may not be used as an excuse for postponing cost-effective measures to prevent environmental degradation; and

- Prevent damage to the environment; if this is not possible, reduce, limit, or control activities that may cause damage (to the environment).

3.2 Assessment Process and Data Synthesis

3.2.1 Overview

The assessment process that has been used in the collection of various data sets used in the Scoping, EIA and EMP stages is summarised in Fig. 3.2 and is in accordance with the provisions of the assessment procedures as outlined in Fig. 3.1. The methodologies and data synthesis were based on a set of interactive knowledge from a variety of sources covering the proposed projects areas. The knowledge that has been created and used at different stages of the assessment process from the desktop study to detailed site-specific assessments consisted of the climatic, environmental and ground components of the natural environment. The climatic components that have been used are precipitation, temperature, evapotranspiration and wind data. The environmental components comprise the type of proposed activities, the likely type of waste, likely contaminants associated with different types of waste including spillages, local ecological (fauna and flora) and community

settings. The ground components cover the regional and local geology, geomorphology, surface water and groundwater assessments.

The phasing process of investigation (specialist studies) covering desktop, preliminary and detailed assessments were adopted (Fig. 3.2). The aim was to evaluate the likely influences and relevance of the proposed project activities on the local climatic, environmental and ground components of the area. During the various stages of the investigation, relevant data sets pertaining to climatic, environmental and ground components of the natural environment were collected and evaluated. The evaluation process for the collected data sets (climatic, environmental and ground) covered a variety of techniques, which included mapping, as well as the matrix approaches.

The climatic, environmental and ground components covered a variety of specialist studies that have been undertaken by highly qualified and independent consultants. The following is a summary of the key specialist studies that have been undertaken with respect to the proposed Kuiseb Delta and Dune Belt projects:

(i) Socioeconomic, current and potential land use zonations;

(ii) Biophysical covering fauna and flora covering the project site and surrounding areas;

(iii) Geomorphology, geology and hydrogeology of the project area;

(iv) Archaeology;

(v) Others to be identified during consultation process and full Environmental Assessment process.

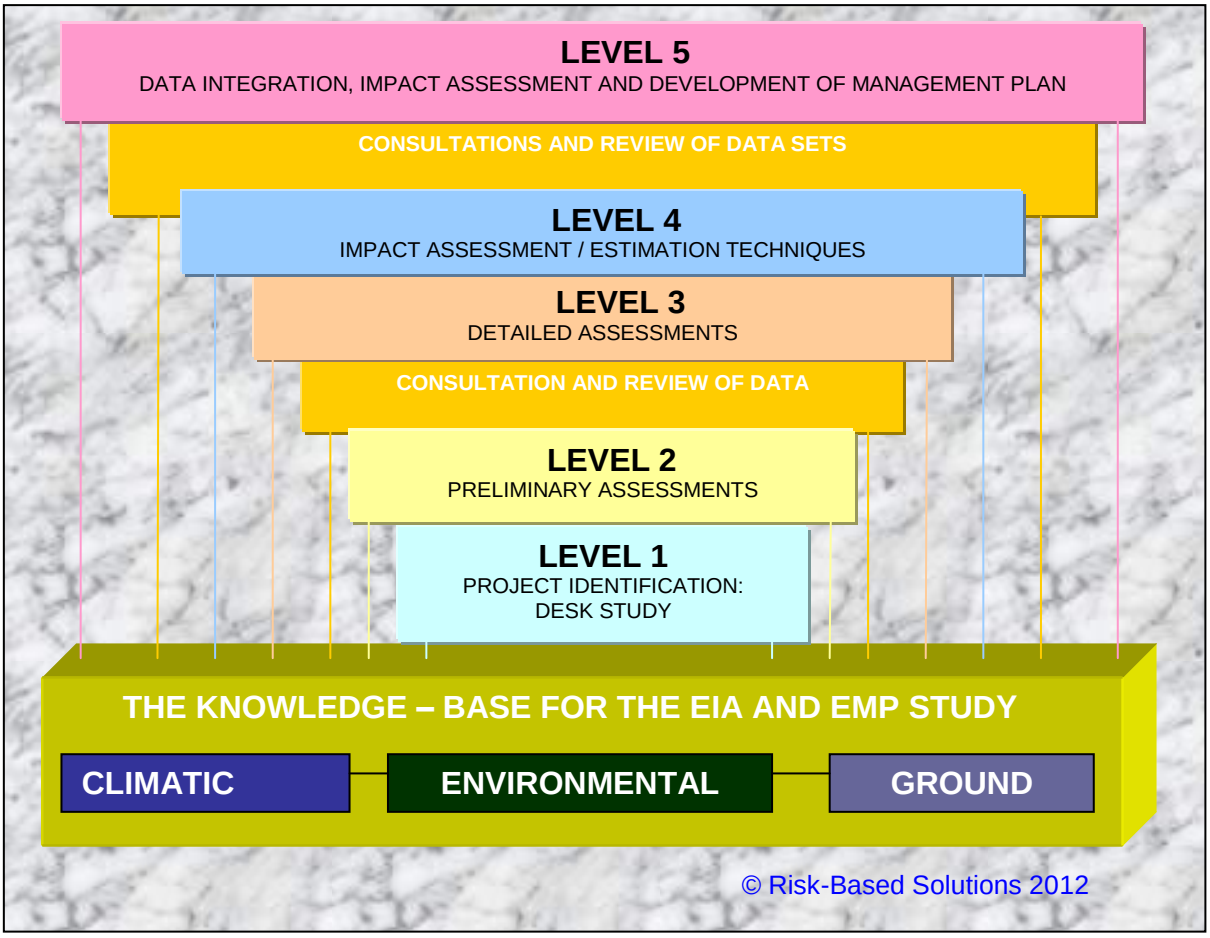


Figure 3.2: A knowledge based approach methodology, an enhanced approach that is in line with Environmental Assessment Process in Namibia.

3.2.2 Climatic Components

Climatic components, which include precipitation and its mode of occurrence, temperature, wind and evapotranspiration, have the most influences on the proposed project activities. Their influences range from mobilising contaminants through wind and water transporting contaminants to various targets in the surrounding areas. In addition climate can affect the type of activities planned in a specific area such as the likelihood of flooding in topographic low areas. The regional climatic data sets used in this study have been obtained from the Meteorological Services Division in Windhoek, Namibia. The analysis and evaluation of climatic data, such as precipitation, wind and temperature has been undertaken using the statistical methods currently employed which include the highest or lowest parameter on record, three or five year rolling averages or ten year period with the highest year average parameter. Uncertainties associated with the data have been minimised using statistical techniques. The results from the assessment have been combined to assess the likely influence of climate on the proposed project activities.

The assessment and interpretation of various data components were focused on the interrelationships that exist within the climatic components and their overall influence on the proposed project activities. Overall, the focus has been on assessment and role of climatic components acting as pathways for contaminant migration including wind and water transport mechanisms. This influence depends on the variability of precipitation, evaporation, transpiration, radiation, temperature and wind patterns.

The likely influence of the proposed project activities on the air quality has been assessed based on the available climatic data. Air pollution is defined as substances in the atmosphere introduced by man including dust and gases, which are liable to cause hazards to the environment, human health, harm to living resources and ecological damage caused through physical or chemical interference with environment. These substances that pollute the environment may be synthetic compounds or naturally occurring substances whose concentration is elevated by anthropogenic activities to levels, which are either toxic or capable of disrupting the ecology of an area. The approach that has been followed in evaluating the likely impacts on the air quality by the proposed project activities is as follows:

- Assessment of existing local meteorological data in relation to potential air quality influences.

The influence assessment indicator guides that have been used with respect to the targets that are likely to be impacted if located within the likely path of a contaminant source that may be associated with the proposed projects over an extended period (at least more than 3 months in year) of exposure are as follows:

(i)	More than 10 km	=	1 (v. low);
(ii)	10, 000 km – 5 km	=	2 (low);
(iii)	5 km – 1 km	=	3 (high); and
(iv)	Less than 1 km	=	4 (very high).

3.2.3 Environmental Components

Environmental components have a vital role in the planning and implementation of effective environmental management and mitigation strategies and practices with respect to the proposed projects activities. The type of the proposed project activities, waste characteristics, ecological and community influences are all-important and play a vital role on the development of effective environmental protection strategies. Evaluations of the influence of the proposed project activities on local fauna and flora have been part of the preliminary and detailed data assessment activities undertaken in form of a specialist study.

The development of any project, such as the proposed activities, has some great positive socioeconomic influences as well as negative influences which include temporal, long or short term impacts on the local fauna and flora, habitants and damage to key archaeological resources through physical tampering. However, environmental interests are also economic interests and the conservation of resources, the survival of ecosystems and the health of the population all have essential roles in the maintenance of the economy. Local communities as well as local and other NGOs were also consulted as part of the detailed Environmental Impact Assessment (EIA) and subsequent development of the Environmental Management Plan (EMP).

3.2.3.1 Ecological Settings

The main reasons for integrating both fauna and flora as a specialist study for the proposed project has been to evaluate:

- The ecological significance and conservation status with respect to the international and local conservation requirements in order to avoid conflicts between development (Proposed Projects) and conservation activities;

- The nature and scale of negative impacts on the ecological setting, which include likely temporal or permanent damage to specific species because of the proposed projects activities from development to operational stages.

Table 3.1 outlines the evaluation guideline that was used for site-specific impacts and influences, possible mitigation measures and site restoration strategies for environmental protection covering fauna and flora likely impacts. Areas with low rainfall have low vegetation density and vice versa. The following is the summary of the general methodological approach that was used in the field assessment process:

- Observational walks and drives were undertaken covering proposed project area. During the observation walks and drive all of the species (both fauna and flora) found were identified and recorded;

- Transect walks were conducted across proposed project area and the surrounding areas. During the transect walks all of the species (both fauna and flora) found were identified and recorded;

Due to the fact that not all of the information could be obtain from only observation and transect walks and drives, consultations were held with the local experts to get some more information on birds and some of the current and future land uses.

Table 3.1: Developed assessment guide for potential project impacts on fauna and flora.

CONSERVATION STATUS [Based on National Legislative Frameworks]	INFLUENCE INDICATORS	AREA AFFECTED AS A % OF THE ORIGINAL HABITAT AREA	INFLUENCE INDICATORS
Very high	4	>50	4
High	3	25-50	3
Low	2	10-25	2
Very low	1	<10	1

3.2.3.2 Assessment of the Local Flora

Assessment of the local flora has been undertaken as part of the specialised studies. The following field methods were employed during the field survey to determine vegetation diversity:

- Literature review: An intensive literature survey (i.e. desktop survey) regarding, shrubs and grasses that could potentially occur in the general/immediate area was conducted to supplement the actual fieldwork;

- Detailed field surveys of the proposed project areas and surrounding areas was undertaken.

3.2.3.3 Assessment of the Local Fauna

Assessment of the local flora has been undertaken as part of the specialised studies. The following field methods were employed during the rapid field survey to determine reptile, amphibian, mammal and avian diversity:

- Literature Review: An intensive literature survey (i.e. desktop survey) regarding reptiles, amphibians, mammals and birds that could potentially occur in the general/immediate area was conducted to supplement the actual fieldwork;

- Detailed field surveys of the proposed project areas and surrounding areas was undertaken.

3.2.3.4 Socioeconomic

The influences of the proposed project activities on the surrounding communities and the Erongo Region as a whole have been divided into two categories namely: perceived and real influences. Real influences can be determined qualitatively and semi-quantitatively whereas perceived influences do not exist in real terms but do exist in people's minds. The likely real influences due to the proposed project are more on the likely impacts associated with the current and future land uses.

Field investigations were focused on the evaluation of likely influences posed by the proposed projects activities with respect to local community aspects, which include the proximity to the nearest settlement area, the location of known archaeological, historical or religious sites as well as the likely impacts as a result of likely expansion of the and the pressures on developable land for residential, commercial and industrial as well as other public urban open spaces by the Walvis Bay Municipality.

3.2.3.5 Archaeological Methodology and Approach

3.2.3.5.1 Significance and Vulnerability Ranking of Archaeological Finds

Archaeological assessment in Namibia follows a basic three-phase process of evaluation – usually by desk study; assessment based on field survey with limited sampling and including proposals for mitigation of impacts (if required); and mitigation – involving detailed field investigation, laboratory analysis and the preparation of site management plans (if required). The assessment process, summarized in the diagram below, may combine evaluation and assessment (as in the present case), and may conclude with assessment if no significant impacts are identified. The present assessment constitutes a Phase 1 evaluation.

The evaluation and ranking of site significance and vulnerability is an essential component of archaeological impact assessment. Quaternary Research Services (QRS) has developed an approach to significance and vulnerability estimation that combines accepted international practice with the results of more than 80 field surveys carried out in Namibia and elsewhere (Fig. 3.3). Standard procedure involves an estimate of the archaeological value and the risk of damage, using ordinal scales of zero to five. These separate values can be combined as a significance and vulnerability index, e.g. 3/2, 4/0. The same data are used in the preparation of archaeological sensitivity maps and predictive models which form the empirical basis of our time and cost estimates for archaeological field surveys.

It is important to realize however, that such estimates have a degree of subjectivity. For this reason, the estimate significance with specific reference to the value of the site as a

component of the Namibian archaeological record, while the estimation of vulnerability refers primarily to the potential consequences of the development project under consideration.

3.2.3.5.2 Significance Ranking

The following is the summary of the significance ranking used:

- 0 no archaeological significance;
- 1 disturbed or secondary context, without diagnostic material;
- 2 isolated minor find in undisturbed primary context, with diagnostic material;
- 3 archaeological site forming part of an identifiable local distribution or group;
- 4 multi-component site, or central site with high research potential;
- 5 major archaeological sites containing unique evidence of high regional significance.

3.2.3.5.3 Vulnerability Ranking

The following is the summary of the vulnerability ranking used:

- 0 not vulnerable;
- 1 no threat posed by current or proposed development activities;
- 2 low or indirect threat from possible consequences of development (e.g. soil erosion);
- 3 probable threat from inadvertent disturbance due to proximity of development;
- 4 high likelihood of partial disturbance or destruction due to close proximity of development;
- 5 direct and certain threat of major disturbance or total destruction.

QRS has adopted the practice of identifying the specific research value of archaeological sites documented in the course of field surveys. This means that the evaluation is focused on the likely research benefits of more detailed investigations on sites of high significance, or local site clusters of potential research importance. The immediate benefits in terms of sequence resolution or yield of comparative material and present this in the form of an expected research dividend are evaluated. Similarly, the consequences of damage or destruction are also evaluated as an expected loss of research dividend. These estimates form part of the proposal for mitigation of impacts.

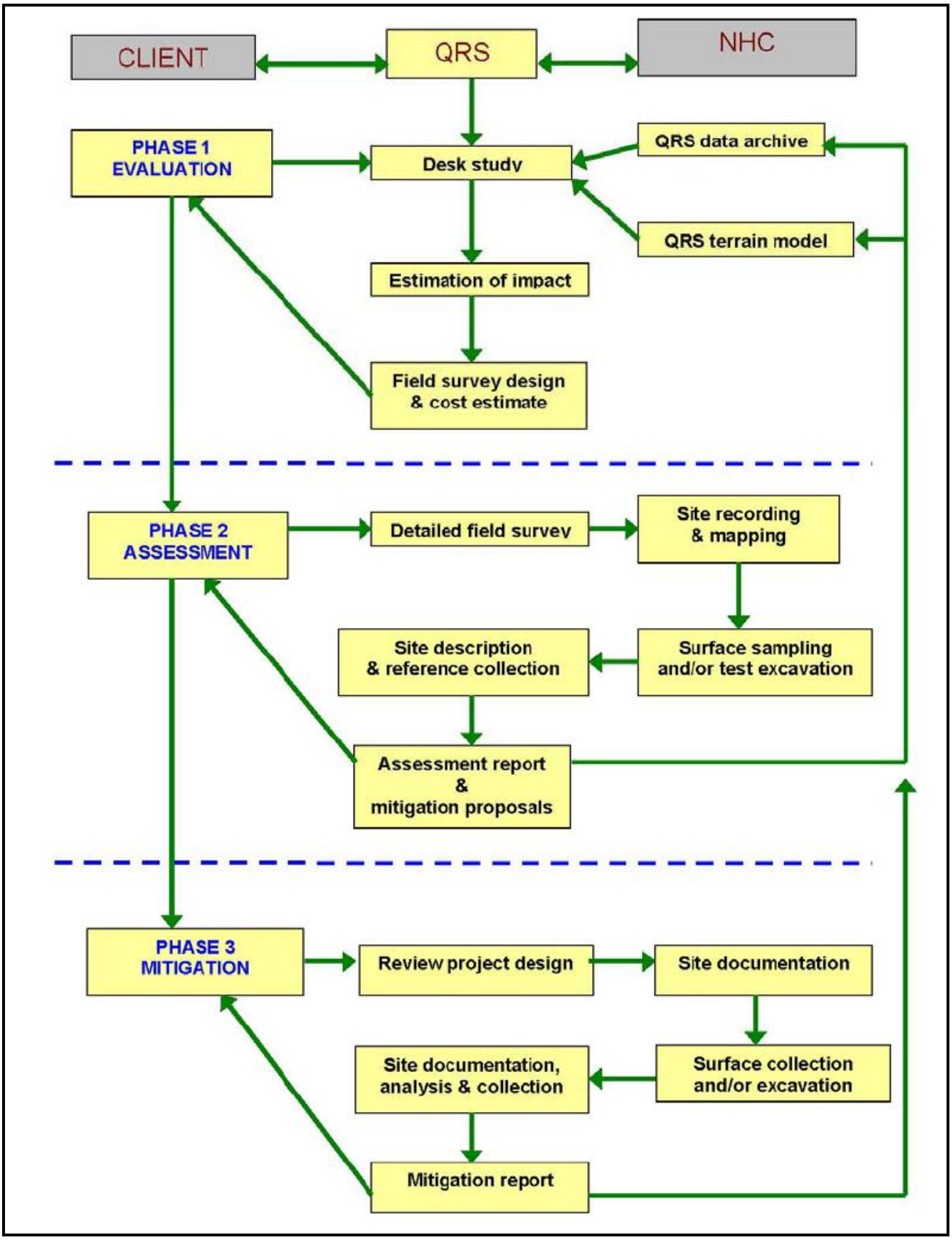


Figure 3.3: The QRS archaeological assessment process.

3.2.4 Ground Components

The methodologies that have been used in the collection and evaluation of the ground components include field mapping, assessment and digitising of the geological,

geomorphological, hydrological and geotechnical engineering information. The geological investigation started with the evaluation of published regional and local topographic, geological and aerial photographic data. The aim has been to establish the regional and local stratigraphy, lithological and structural variations of the area. Detailed field surveys of the proposed project area were undertaken and various maps have been produced.

As part of the ground component, the geomorphic mapping of the study area was done in sequences. Desk study, which included literature review and preliminary image classifications, was followed by fieldwork. Ground truthing was thus carried out as an indispensable component of remote sensing image evaluations and classifications.

Two sets of aerial photographs (digital), chromatic and pan-chromatic, were acquired from the National Planning Commission and the Surveyor's General Office, respectively. The first set covers the immediate surroundings areas of Swakopmund and Walvis Bay, while the set of pan-chromatic data covers the entire study area. The chromatic set was acquired in 2010 with a spatial resolution of 2 m; whereas the other set was acquired in 1997 at a scale of 1:78 000.

In addition, two images of the Landsat TM and Landsat TM+ were obtained from the University of Maryland website. These images were acquired in May 1992 and April 2005. Both sets were pre-processed in terms of radiometric and geometric corrections. Employing ILWIS 3.7, the process of pan-sharpening and image stretching using histogram equalization were carried out for enhancing visual image interpretations. Terrain mapping units were then onscreen digitized, variously making use of all images mentioned above at a nominal scale of 1: 50, 000. In addition, attributes of the identified terrain units were entered and stored in the attendant table.

3.2.4.1 Evaluation of Surface and Groundwater

An assessment of likely impacts of the proposed project activities on the surrounding ephemeral channel was undertaken as part of the field investigation. Overall, the focus of the field investigation with respect to water assessment has been to:

- Determine the likely influence of the proposed project on the local water resources in general;
- Determine the likely future negative impacts of the proposed projects and in particular the proposed location of the specific infrastructures on the local water resources;
- Assess the likely impacts of possible groundwater uses for construction and maintenance purposes;
- Determine other likely negative impacts that may influence the water quality in the general area with respect to the proposed project activities.

The evaluation of groundwater in this area has been based on the interpretations of the regional and local geological data sets collected in form of a specialist study. The initial data was obtained from the databases of the Department of Water Affairs and the Geological Survey of Namibia. These databases contain borehole records, technical reports and maps on groundwater and surface water occurrences throughout the country. The focus in the data evaluation was to determine the presences of groundwater that may be contaminated by the proposed project activities. This was achieved by evaluating the type of aquifer (confined or

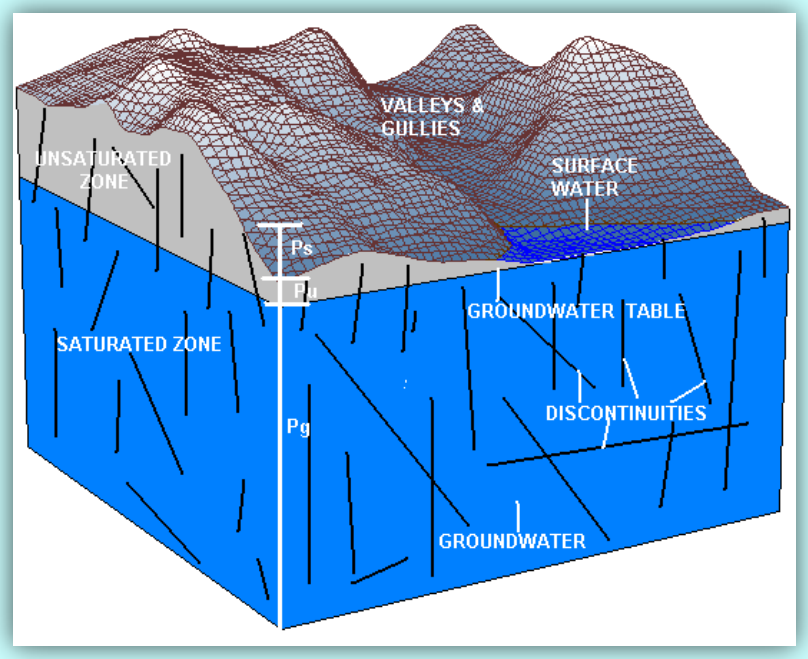
unconfined), porosity, permeability, hydraulic conductivity as well as other hydrological properties affecting and influencing the groundwater flow both in saturated and unsaturated zones around the proposed project area.

3.2.4.2 Evaluation of Water Vulnerability

Vulnerability is a term that has been used in the assessment of the potential for any contaminant source to migrate from the locations of the proposed project activities to existing groundwater or surface water resources. The knowledge-based approach that was used integrated the potential pollution influences, site characteristics and consequences of influence in the development of efficient protection strategies using probability assessments (Fig. 3.4). The vulnerability approach consists of source-pathway-target factors and has been divided into two parts, which include surface and groundwater. The surface water assessments covered runoff, the presence of source factors and major flow routes such as ephemeral rivers, valleys and gullies as pathways and the presence of surface water body as a target.

The groundwater assessments covered hydraulic properties and thickness of the unsaturated and saturated zones derived from geological and hydrogeological data (Fig. 3.4). The assessment of the unsaturated characteristics was based on the ability for source factors to influence the system through known pathway factors such as discontinuities (Fig. 3.4). The combined effects of unsaturated and saturated flow probabilities were used as indicator for groundwater vulnerability. However, groundwater or surface water will only be vulnerable to contamination if there are contaminant sources, if there are pathways for contaminant migration and there are targets (surface water or groundwater) present.

A number of other qualitative and quantitative vulnerability assessment techniques have been developed (Department of Water Affairs, 2001). The DRASTIC Model is among the most common vulnerability technique, which is a vulnerability mapping technique based on qualitative methods utilising hydrological factors. The factors are evaluated according to the determined relative influences on water vulnerability. The DRASTIC approach has also been incorporated in the Water Vulnerability Model Approach (WVMA) shown in Fig. 3.4 and has been used for water vulnerability assessment. The results from the assessment formed part of the constraint layer that has been created as part of the Decision Support Tools (DSTs).



Where:
Ps is the Probability Indicator [**0 -1**] for Surface Water Contamination
Pu is the Probability Indicator [**0 -1**] for Water flow in the Unsaturated Zone
Pg is the Probability Indicator [**0 -1**] for Groundwater Contamination

PROBABILITY INDICATORS	VULNERABILITY INDICATOR	
SOURCE - PATHWAY - TARGET	SURFACE WATER	GROUNDWATER
0	Very Low [ID1]	
0.3	Low [ID2]	
0.6	High [ID3]	
0.9	Very High [ID4]	

SURFACE WATER VULNERABILITY = Vs = Ps

[**Ps**] Probability of surface water contamination = f [Source, Pathway, Target]
Where:
Source denotes contaminant presence
Pathway denote presence of routes for contaminant migration
Target denote presence of surface water body / bodies

GROUNDWATER VULNERABILITY = Vg = [Pu x Pg]

[**Pu**] Probability of contaminant movement through the unsaturated zone
= f [Source, Pathway]
[**Pg**] Probability of Groundwater contamination = f[Source, Pathway, Target]
Where:
Source denotes contaminant presence
Pathway denote presence of routes for contaminant migration
Target denote presence of groundwater body / bodies

Figure 3.4: Surface water and groundwater knowledge-based vulnerability approach.

3.2.5 Environmental Impact Assessment and Management

3.2.5.1 Impact Assessment Criteria

The quality of the environment, both natural and man-made structures, is essential to the proposed projects activities. However, the relationship of the proposed project with the environment is complex. It involves many activities that can have adverse environmental effects. Many of these impacts are linked to the various project developmental stages such as the construction of the general supporting infrastructure such as surrounding access and of local facilities. The negative impacts of the proposed development can gradually destroy the environmental resources which it was meant to promote. On the other hand, the proposed development has the potential to create beneficial effects on the environment by contributing to environmental protection and conservation of the identified key environmental resources as well as contribute to the socioeconomic upliftment of the Topnaar communities as well Walvis Bay, the Erongo region and Namibia as a whole. The impacts of tourism activities on the environment were evaluated in terms of nature of impact (identification), magnitude, extent, duration and significance as outlined in the Table 3.2.

Table 3.2: Criteria used to evaluate impacts.

Criteria	Categories
Nature of Impact	Description of the effect of a proposed/existing activity on the environment. - Positive - Negative - Direct - Indirect - Cumulative - Synergistic
Magnitude	- Severe - Moderate - Low
Extent	- International - National - Regional - Local
Duration	- Short term - Long term - Project Life Span - Permanent
Significance	- High - Medium - Low

4. REGULATORY FRAMEWORK

4.1 Introduction

The constitution is the Namibian fundamental law of its sovereign and independent republic and a driving principle for all regulatory frameworks or Act promulgated. Article 95, chapter 11 of the constitution emphasizes on the promotion and maintenance of the welfare of the people by adopting inter alia policies with much emphasize on *maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future*. This has resulted in the development and promulgation of a number of binding legal environmental policies, Act and regulations. The relevance of the Constitution to environmental management can be taken from Article 95: Promotion of the Welfare of the People. This affirms that the State shall actively promote and maintain the welfare of the people by adopting policies aimed at the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future.

4.2 International Treaties and Protocols

Article 144 of the Constitution provides the enabling mechanism to ensure that all ratified international treaties and protocols listed below are enforceable within Namibia by the Namibian courts:

- Convention on Biological Diversity, 1992;
- Vienna Convention for the Protection of the Ozone Layer, 1985;
- Montreal Protocol on Substances that Deplete the Ozone Layer, 1987;
- United Nations Framework Convention on Climate Change, 1992;
- Kyoto Protocol on the Framework Convention on Climate Change, 1998;
- Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal, 1989;
- World Heritage Convention, 1972;
- Convention to Combat Desertification, 1994; and
- Stockholm Convention of Persistent Organic Pollutants, 2001.

4.3 National Legislations

4.3.1 Overview

Important legislative instruments that affect the feasibility, preconstruction, construction and operation of the proposed Kuiseb and Dune Belt Projects development as outlined in Table 4.1.

Table 4.1: Legislation relevant to the proposed Kuiseb Delta and Dune Belt Projects.

LAW	SUMMARY DESCRIPTION
Constitution of the Republic of Namibia, 1990	The Constitution is the supreme law in Namibia, providing for the establishment of the main organs of state (the Executive, the Legislature and the Judiciary) as well as guaranteeing various fundamental rights and freedoms. Provisions relating to the environment are contained in Chapter 11, article 95, which is entitled "promotion of the Welfare of the People". This article states that the Republic of Namibia shall – "actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at … maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for all Namibians, both present and future; in particular, the Government shall provide measures against the dumping or recycling of foreign nuclear waste on Namibian territory."
Environmental Management Act (2007) - ***Ministry of Environment and Tourism*** **(MET)**	The purpose of the Act is *to give effect to Article 95(l) and 91(c) of the Namibian Constitution by establishing general principles for the management of the environment and natural resources; to promote the co-ordinated and integrated management of the environment; to give statutory effect to Namibia's Environmental Assessment Policy; to enable the Minister of Environment and Tourism to give effect to Namibia's obligations under international conventions*. In terms of the legislation it will be possible to exercise control over certain listed development activities and activities within defined sensitive areas. The listed activities in sensitive areas require an Environmental Assessment to be completed before a decision to permit development can be taken. The legislation describes the circumstances requiring Environmental Assessments. Activities listed as per the provisions of the Act will require Environmental Assessment unless the Ministry of Environment and Tourism, in consultation with the relevant Competent Authority, determines otherwise and approves the exception.
Water Act 54 of 1956 **Minister of Agriculture, Water and Forestry**	This Act provides for the control, conservation and use of water for domestic, agricultural, urban and industrial purposes. In terms of Section 6, there is no right of ownership in public water and its control and use is regulated and provided for in the Act. In accordance with the Act, the proposed project must ensure that mechanisms are implemented to prevent water pollution. Certain permits will also be required to abstract groundwater (already obtained) as well as for "water works". The broad definition of water works will include the reservoir on Site (as this is greater than 20,000m^3), water treatment facilities and pipelines. Due to the water scarcity of the area, all water will be recycled (including domestic wastewater) and the project will be operated on a zero discharge philosophy. It will, therefore, not be necessary to obtain permits for discharge of effluent. Section 23 of the Act requires environment rehabilitation after closure of the project, particularly, in this instance to obviate groundwater pollution and potential pollution resulting from run-off. This Act is due to be replaced by the Water Resources Management Act 24 of 2004.
Forest Act 12 of 2001 - **Minister of Agriculture, Water and Forestry**	Under Section 22(1) of the Act it is unlawful for any person to: cut, destroy or remove: (a) any vegetation which is on a sand dune or drifting sand or in a gully unless the cutting, destruction or removal is done for the purpose of stabilising the sand or gully or (b) any living tree, bush or shrub growing within 100m of a river, stream or watercourse. Should either of the above be unavoidable, it will be necessary to obtain a permit from the Ministry.
Hazardous Substance Ordinance 14 of 1974 ***Ministry of Health and Social Services***	Provisions for hazardous waste are amended in this act as it provides "*for the control of substances which may cause injury or ill-health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure thereby in certain circumstances; to provide for the prohibition and control of the importation, sale, use, operation, application, modification, disposal or dumping of such substance; and to provide for matters connected therewith"*

Table 4.1: *Cont.*

LAW	SUMMARY DESCRIPTION
The Labour Act, 2007 (Act No. 11 of 2007)	The labour Act gives effect to the constitutional commitment of Article 95 (11), to promote and maintain the welfare of the people. This Act is aimed at establishing *a comprehensive labour law for all employees; to entrench fundamental labour rights and protections; to regulate basic terms and conditions of employment; to ensure the health, safety and welfare of employees* under which provisions are made in chapter 4. *Chapter* 5 of the act improvises on the *protection of employees from unfair labour practice.*
Petroleum Products and Energy Act 13 of 1990 ***Ministry of Mines and Energy***	Any consumer installation as envisaged in this Act has to be licensed. Appropriate consumer installation certificate will need to be obtained from the Ministry for each fuel installation. The construction of the installation has to be designed in such a manner as to prevent environmental contamination. Certificate holders are obliged to submit annual reports to the Minister in respect of the status of all storage tanks with a capacity of 2,200ℓ or more in the case of above ground storage tanks and with a capacity of more than 4,560ℓ in the case of below ground storage tanks. Any certificate holder or other person in control of activities related to any petroleum product is obliged to report any major petroleum product spill (defined as a spill of more than 200ℓ per spill) to the Minister. Such person is also obliged to take all steps as may be necessary in accordance with good petroleum industry practices to clean up the spill. Should this obligation not be met, the Minister is empowered to take steps to clean up the spill and to recover the costs thereof from the person. General conditions apply to all certificates issued. These include conditions relating to petroleum spills and the abandonment of the Site. The regulation further provides that the Minister may impose special conditions relating to the preparation and assessment of environmental assessments and the safe disposal of petroleum products.
National Heritage Act 27 of 2004 ***Ministry of Youth, National Service, Sport and Culture***	This Act provides provisions for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. The proposed projects will ensure that if any archaeological or paleontological objects, as described in the Act, are found in the course of its construction, that such find be reported to the Ministry immediately. If necessary, the relevant permits must be obtained before disturbing or destroying any heritage
Atmospheric Pollution Prevention Ordinance 11 of 1976; Ministry of Health and Social Services	This regulation sets out principles for the prevention of the pollution of the atmosphere and for matters incidental thereto. Part III of the Act sets out regulations pertaining to atmospheric pollution by smoke. While preventative measures for dust atmospheric pollution are outlined in Part IV and Part V outlines provisions for Atmospheric pollution by gases emitted by vehicles.
The Nature Conservation Ordinance, Ordinance 4 of 1975, Ministry of Environment and Tourism (MET)	In the course of the Mine's activities, care must be taken to ensure that protected plant species and the eggs of protected and game bird species are not disturbed or destroyed. If such destruction or disturbance is inevitable, a permit must be obtained in this regard from the Minister of Environment and Tourism. Should the project developer decide to operate a nursery in order to propagate indigenous plant species for rehabilitation purposes, a permit will be required. At this stage, however, it is envisaged that this type of activity will be contracted out to encourage small business development

4.3.2 Regulatory Agencies and Permitting

The environmental regulatory authorities responsible for environmental protection and management in relation to the proposed projects including their role in regulating environmental protection are listed in Table 4.2. Table 4.3 shows an extract from the legal instruments of the regulating authorities with respect to the relevant permits / licenses required for the proposed projects.

Table 4.2: Permit requirements.

Activity	Applicable Legislation	Permitting Authority	Current Status
1. Concession	Concession and Tourism Policy	Ministry of Environment and Tourism (MET)	**Concession Already Granted for the Kuiseb Delta Project**
2. EIA Clearance	Environmental Management Act, 2007, (Act No. 7 of 2007), Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995)		**To be applied on completion of the Scoping, EIA and EMP Report**
3. Construction, alteration of waterworks with capacity to hold in excess of 20,000L.	Water Act 54 of 1956 Water Resources Management Act, 2004 (No. 284 of 2004).	Ministry of Agriculture, Water and Forestry	**To when and if Required**
4. Abstraction of water other than that provided by Nam Water.			
5. Discharge of effluents or construction of effluent facility or disposal site.			
6. Removal, disturbances or destruction of bird eggs.	Nature Conservation Ordinance 4, 1975.	Ministry of Environment and Tourism (MET)	**No removals anticipated**
7. Removal, disturbance of protected plants.			
8. Removal, destruction of indigenous trees, bushes or plants within 100 yards of stream or watercourse.	Forestry Act, 12 of 2001.	Ministry of Water Affairs and Forestry (MWAF)	
9. Scheduled processes in controlled area.	Atmospheric Pollution Prevention Ordinance 11 of 1976	Ministry of Health and Social Services.	**No Permits Require but to meet Provisions**
10. Discarding or disposing of used oil.	Petroleum Products and Energy Act 13 of 1990	Ministry of Mines and Energy (MME).	**To Apply when and if Required**
11. Operating a petroleum consumer installation.			
12. Construction of small scale (Formal) water supply schemes.	Water Act 54 of 1956 Water Resources Management Act, 2004 (No. 284 of 2004).	Ministry of Agriculture, Water and Forestry	**To Apply when and if required**
13. Construction of waste disposal sites.	Environmental Policy and Environmental Management Act, (Act No. 7 of 2007)	Ministry of Environment and Tourism (MET)	

4.4 Other Key National Policies

4.4.1 Environmental Assessment Policy

Any development project initiated by the government or private sector is subject to an Environmental Assessment procedure as required and recognized by the Environmental Assessment Policy for Sustainable Development and Environmental Conservation of 1995. This policy promotes sustainable development and economic growth while safeguarding the environment in the long run. The government recognizes that environmental assessments are key tools to further the implementation of a sound environmental policy, which strives to achieve Integrated Environmental Management. The main purpose of the policy takes lead as an informing decision makers and promoting accountability, ensuring that alternatives and environmental costs and benefits are considered, promoting the user (polluter) pays principle, and promoting sustainable development.

The principles set out to;

- Better inform decision-makers;
- Consider a broad range of options and alternatives when addressing specific projects;
- Strive for a high degree of public participation and involvement;
- Take into account the environmental costs and benefits;
- Incorporate internationally accepted norms and standards where appropriate;
- Take into account secondary and cumulative environmental impacts; and
- Promote sustainable development and, especially to ensure that a reasonable attempt is made to minimise possible negative impacts and maximise benefits.

4.4.2 Dorob National Park Draft Regulations

The Ministry of Environment and Tourism has developed Draft Regulations for the Dorob National Park. These regulations specify what is permitted or not permitted in the Dorob National Park (DNP) of the Namib-Skeleton Coast National Park (NSCNP) (hereinafter referred to as 'the park'. They are a compliment to the Management and Development Plan (MDP) of the NSCNP. Thus, an issue not included in the regulations, but covered in the MDP, is in such cases regulated by the text in the MDP. The following is summary of the key the areas of the DNP Draft Regulations applicable to the proposed Kuiseb Delta and Dune Belt proposed projects activities:

(i) Public Access;

(ii) Signage, advertising and structures;

(iii) Tourism and Concessions;

(iv) Plant and animal harvesting;

(v) Waste, pollution and litter.

4.4.3 Other Policies

- General:
  - Namibia's Green Plan;
  - Vision 2030;
  - Regional Development Strategy;
- Environmental Management:
  - Namibia's 12 Point Plan for Integrated and Sustainable;
- Water:
  - National Water Policy White Paper 2000;
  - Water and Sanitation Policy;
  - Integrated Water Resource Management and Water Demand Management Policy;
- Tourism:
  - White Paper on Tourism Policy;
  - Concessions Policy;
  - Policy on Community-Based Tourism Development;
- Energy:
  - White Paper on Energy Policy;
- Land:
  - National Land Policy;
  - National Resettlement Policy;
  - Land Use Planning Policy;
- Agriculture:
  - National Agriculture Policy;
- Biodiversity and Forestry:
  - Development Forestry Policy for Namibia;
  - Conservation and Biotic Diversity and Habitat Protection Policy;
  - Policy Framework for Wildlife and Utilisation Production in Support of Biodiversity Conservation and Economic Development;
  - National Policy on the Safe Use of Biotechnology;
  - Community Based Natural Resource Management (CBNRM) Policy

5. DESCRIPTION OF THE PROPOSED PROJECTS

5.1 General Overview

Through the NACOMA Project Co-ordinating Office (PCO) and the Steering Committee, a number of investment proposals were approved for implementation under the World Bank Matching Grant support. The NACOMA Project Sub-component 3.2 is concerned with provision of technical support and small matching grants for targeted investments in specific project intervention sites. Kuiseb Delta Development Trust (KDDT) and Walvis Bay Bird Paradise were among approved proposals and MG's recipients. Part of the technical support is to identify activities to be funded through the NACOMA MG, to facilitate a feasibility study and carry out an EIA screening to determine if there are significant or no significant impacts requiring an assessment. However, the scope of this consultancy is to also focus on other activities currently operating in the area as well as identify potential eco-tourism and recreational activities in the Kuiseb Delta and Dune Belt area.

5.2 Kuiseb Delta Development Project/ Trust (KDDP/T)

5.2.1 The Kuiseb Delta

Kuiseb Delta is located in Erongo region which is considered the hub of tourism in Namibia (Fig. 5.1). KDDP is located in an ideal tourism location - the meeting place of extreme landscapes. On the one side is the Namib Desert, the oldest desert in the world while on the other side is a massive lagoon and harbour flowing from the Atlantic Ocean. Both of these landscapes lend themselves towards some of the most unique site seeing opportunities in Namibia. The lagoon and harbour is home to a variety of species and a large number of sea mammals and bird life. The Namib Desert on the other side is called "The Living Desert", because of the large number of living species found there. Activities include various different water related actions, like shore angling, boat angling, shark angling, sightseeing and photographic boat cruises, sea kayaking and wind- and kite surfing. Walvis Bay houses yearly one of the international legs of speed kite and wind surfing. The proposed project provides additional activities in the coastal area. Envisaged facilities and attendant activities will complement existing offerings. The additional activities will boost current efforts to lengthen the average stay of tourists in the coastal area (Nyakunu and Ndlovu, 2010).

5.2.2 Kuiseb Delta Development Project (KDDP)

The Topnaars community living in the Kuiseb Delta, submitted an application for a Matching Grant to NACOMA with the main aim of establishing Community-Based Tourism (CBT), called the Kuiseb Delta Development Project (KDDP). Upon approval of the Matching Grant the KDDP submitted an application for a concession along the Kuiseb Delta to MET. Conditions for concession applications required a feasibility report and business plan. Subsequently, The Kuiseb Delta Development Trust (KDDT) was registered on April 12, 2010 through a Trust Deed, in terms of the Trust Monies Protection Act. The trust is a legal entity that can venture into formal commercial agreements with business partners. It is an initiative being spearheaded by seven (7) Trustees from the Topnaar community with the consent of the Topnaar Traditional Authority. The trust comprises of 600 registered members. Clear guidelines on benefits distribution, mandates and responsibilities have been drafted and a Steering Committee comprising the Trustees is functioning. The concession which KDDT has applied for spans the area east from Walvis Bay Meersig residential area, starting from the border of Walvis Bay and state lands till Mile 7 reservoir including old Walvis Bay entry route near the MWARD nursery (Fig. 5.1).

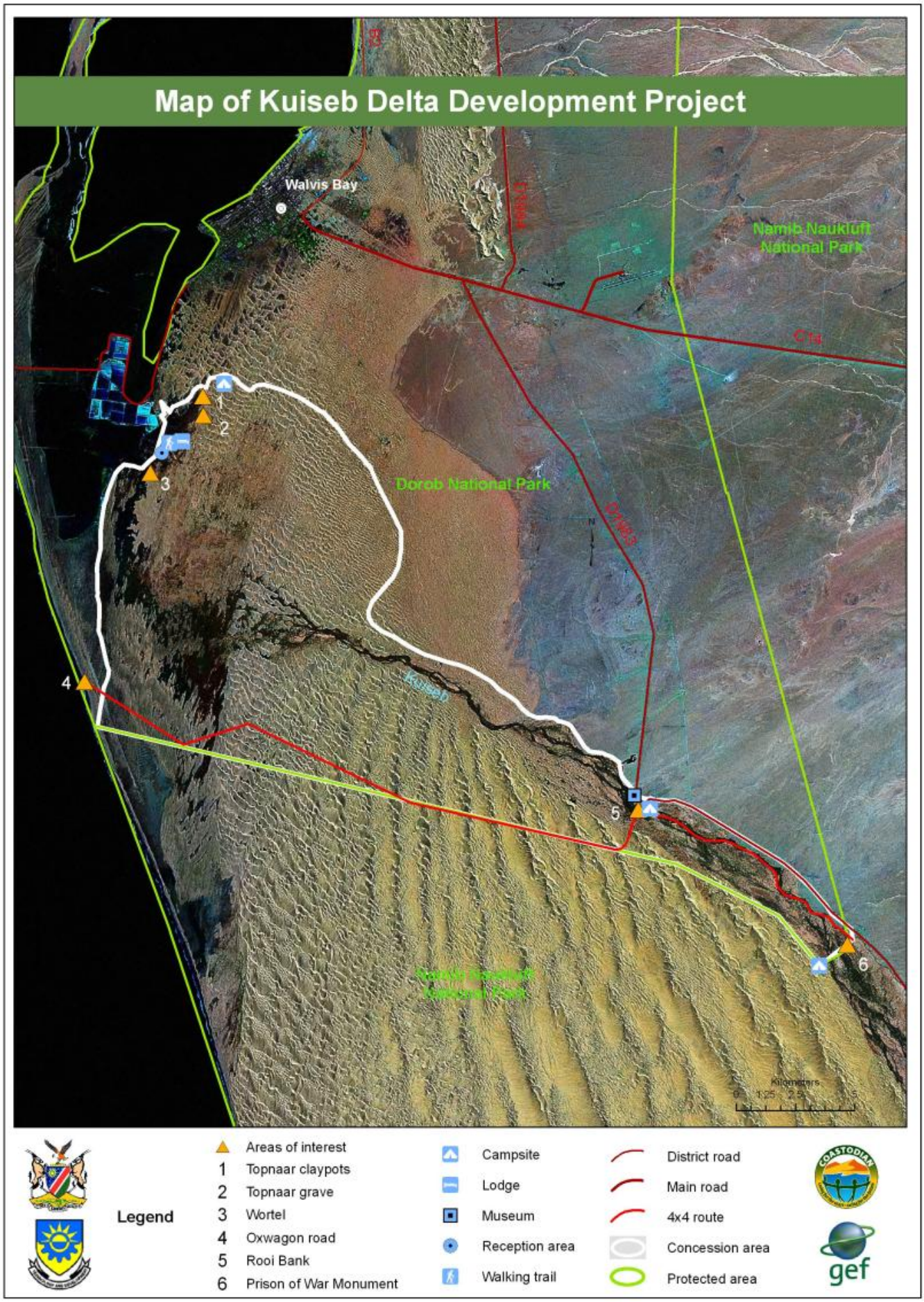


Figure 5.1: Kuiseb Delta Development Trust Concession Area (Nyakunu and Ndlovu, 2010).

5.2.3 KDDP Proposed Project Activities

The Kuiseb Delta Development Project (KDDP) seeks to offer more specialised tourism services such as cultural tourism, educational/historical tourism and adventure tourism through the provision of walking trails, scenic drives, dune drives, sand boarding, and other activities relevant to its locality (Nyakunu and Ndlovu, 2010). KDDP is a significant initiative since and according to the feasibility study prepared by Nyakunu and Ndlovu, (2010), it confirms that the project is significant and reasons for justification are as follow:

- The Topnaar community will bring forth a rich cultural component to the trails. The existing traditional customs and cultural harvesting of the !Nara presents another mile stone in the promotion of cultural tourism. The historical and educational component of the trail provides the overall experience;

- The successful launch of the project will be another feature in the cap of CBNRM in Namibia. It will be an additional opportunity to showcase Namibia's international success in the promotion of CBRNMs;

- Focus is on and around ecosystems of biodiversity importance i.e. bio-diversity being conserved includes !Nara melons, Dune lark, Lichen fields, Dune habitats and gravel plain habitats, landscape aesthetics, restriction of ORV traffic, etc;

- It is aligned with community / local and national priorities such as empowering rural communities through the provision of consumptive and non-consumptive rights over natural resources, raising standard of living, creating employment opportunities, alleviating poverty, etc;

- The project will also include cottage industries and conservation issues;

- The Kuiseb Delta is unparalleled in Southern Africa for its archaeology which provides a continuum of 2000 years, including detailed evidence from the last 250 years. By 1990s, 235 sites had been identified with 75% being from pre-contact times and 25% showing evidence of contact ranging in age from 15th to 20th century. Though well preserved the sites are vulnerable to natural and human influences. For instance, the removal of items is reducing the archaeological / historical value of the sites which is important to the nation and paramount to the Topnaar people.

KDDT can sell the project and generate funding for both capital and running costs. The KDDP can be easily operated at a marginal cash surplus but would rely heavily on collections from membership fees, labour subsidies for construction and maintenance, donations and subsidized supplies for construction and maintenance. According to the KDDT business plan, it is assumed that revenues will be generated solely from activities such as trails, camping and guiding fees. These income streams will cover sufficiently the capital, construction and operating funding needs of the project (Nyakunu and Ndlovu, 2010).

5.3 Walvis Bay Bird Paradise

5.3.1 Overview

The application for a Matching Grant to establish a bird watch paradise in Walvis Bay was also submitted to NACOMA PCO. Subsequently, the feasibility and business plan was compiled to guide the construction and operation of the project. Setting up a bird watching camp was welcomed by everybody spoken to, no matter whether they were birders, people

involved in tourism & NGO's or officials in government or public institutions. It was actually often queried why a country with a very high ranking in its bird variety has to date not seen an operation of this kind set up. The Walvis Bay Bird Paradise is situated 1300m from the circle of the intersection of the Swakop – Walvis Bay road (B2) and the road to the Walvis Bay Airport / into the Namib (C14). The Walvis Bay sewerage ponds where the paradise camp is erected is about 200m form the road. The pond is the most north-east of the reticulation pans of the reticulation plant. It is visible from the road; it can be accessed by a short gravelled up ramp from the main road. Separated by 2 dunes to the south-east is the water carrying pan with a range of birds, both sweet water and sea water birds.

5.4 Existing Activities in the Kuiseb Delta and Dune Belt Areas

Erongo Region is one of the most economically active regions in the country. Its' economy rely heavily on Fisheries, Mining and Tourism. The study area between Swakopmund and Walvis Bay is concentrated with Tourism and recreational activities (Fig. 5.2). Coastal tourism is one of the priority economic areas for local, regional and national development. Community-based tourism provides avenue to local communities in the area (NACOMA, 2007). This area is also subject to intensive recreational pressure during peak holidays (NACOMA, 2004). According to the BGR (2008) tourism products in the area include adventure tourism, business tourism, non-consumptive tourism and ecotourism. As such, the Dune belt area is the only coastal dune area that is easily accessible to the public (NACOMA, 2004). As such, the area is important for multiple tourism use practices in the tour operator sector. The area also contains a diversity of biophysical features and attractive landscape. Land-based and nature-based tourism activities in the study area are included in itinerary for trips from the coast into Kunene region, notably Twyfelfontein (NACOMA, 2007).

The following activities are identified by (NACOMA, 2007) study:

- Desert tours;
- Sightseeing trips;
- Tours to Dune 7;
- Dune-boarding;
- Quad biking;
- 4X4 Off-road recreational driving;
- Paragliding;
- Scenic flights;
- Filming and Photography.

The KDDP and Trust was only established during 2009/10 while a number of unregulated tourism activities have been taking place in the Delta over the past years. However, there are some regulated tourism-based activities led by Topnaars community. The following activities are currently taking place in the Delta (Mufita, 2011pers.com):

- Tour guide: 4x4 vehicles and quad bikes off-road driving;

- Bush camps;
- Walking trials, hiking and sand boarding;
- Camping site;
- Scenic Flights;
- Tour operators marketing self-touring products in their itinerary.

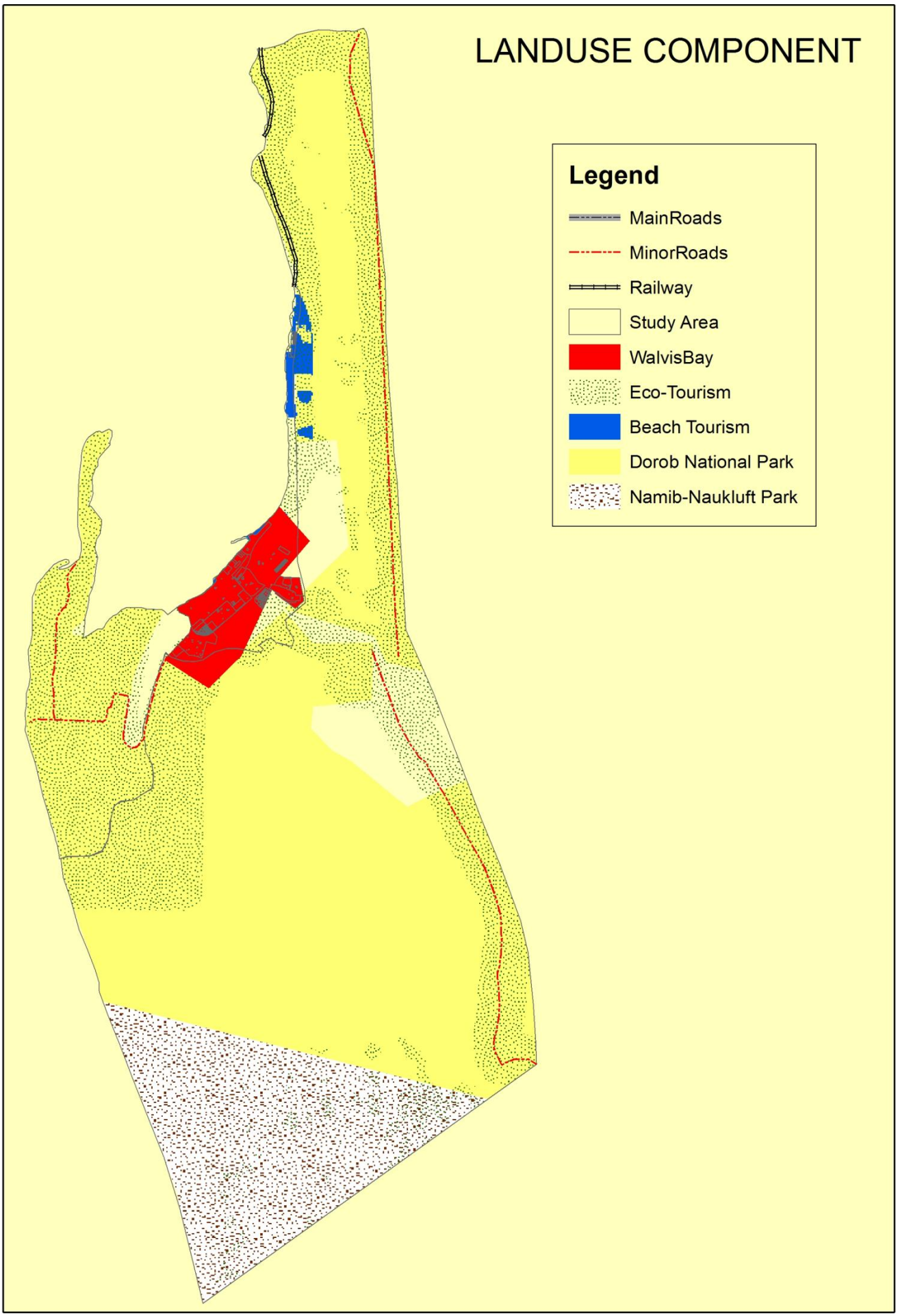


Figure 5.2: Current land uses of the study area.

5.5 Sub Regional Concepts

The sub-regional concept of Walvis Bay as outlined in Fig. 5.3, provides for demarcation of defined zones to accommodate existing and future land uses. The following is an extract summary from the sub-regional concept document for Walvis Bay outlining the various zones:

- **Walvis Bay Nature Reserve**: The zone is on the southern part of Walvis Bay, roughly from the southern edges of Farms 29, 37 and 38 to the Kuiseb River. The Lagoon, the Salt-Works and the Topnaar community settlement are located in this zone… Since this zone is ecologically fragile, in such a way that it supports unique and fascinating ecological communities, it is recommended to be left free of any development other than those relating to cultural and ecotourism and/or aqua-culture/agriculture. All existing developments located in this area should continue their activities in this area. However, new applications of such kind will not be allowed;

- **Conservation:** This area includes Farms owned by Council, part of the coastline between Walvis Bay and Swakopmund, part of the dune belt and the area immediately adjacent to the Swakop River Bed…Activities relating to environmental conservation education, and/or eco-tourism. Off road vehicles are prohibited in this area. Quad bikes and all other off road vehicles are not allowed in this zone;

- **Recreation:** Five areas are demarcated as recreation zones: South of the Swakop River, East of Long Beach, North – West of the Tumas River, Dune 7, and the coastline along Long Beach and Dolphin Park. Quad bikes as well as all other off road vehicles will only be accommodated in the *dunefield* part of this zone. All off road vehicles are to be led into the dunes via fixed tracks. Quad bikes are prohibited in the beach area (i.e. the coastline along Long Beach/Dolphin Park) of the recreation zone;

- **Industrial**: The zone comprises of the areas demarcated for the heavy industrial development behind the dune belt. Noxious and nuisance creating industries should be located in this area;

- **Government:** The zone is bounded by the Tumas River on the South and the gravel road between Walvis Bay and Swakopmund on the West… Zone 5 will permit only military related activities;

- **Land for Development:** This includes the area just south of the Airport and Dune 7 and South-East of the 'built-up urban area' as well as the Long Beach/Dolphin Park development. The node at Long Beach/Dolphin Park can be strengthened. Developments at Long Beach/Dolphin Park have to abide to this policy…With the exception of the Long Beach/Dolphin Park development, any other proposed development in this area should be: scattered, not agglomerated, to allow the dominant presence of the desert to be maintained, and are subject to an Environmental Impact Assessment.

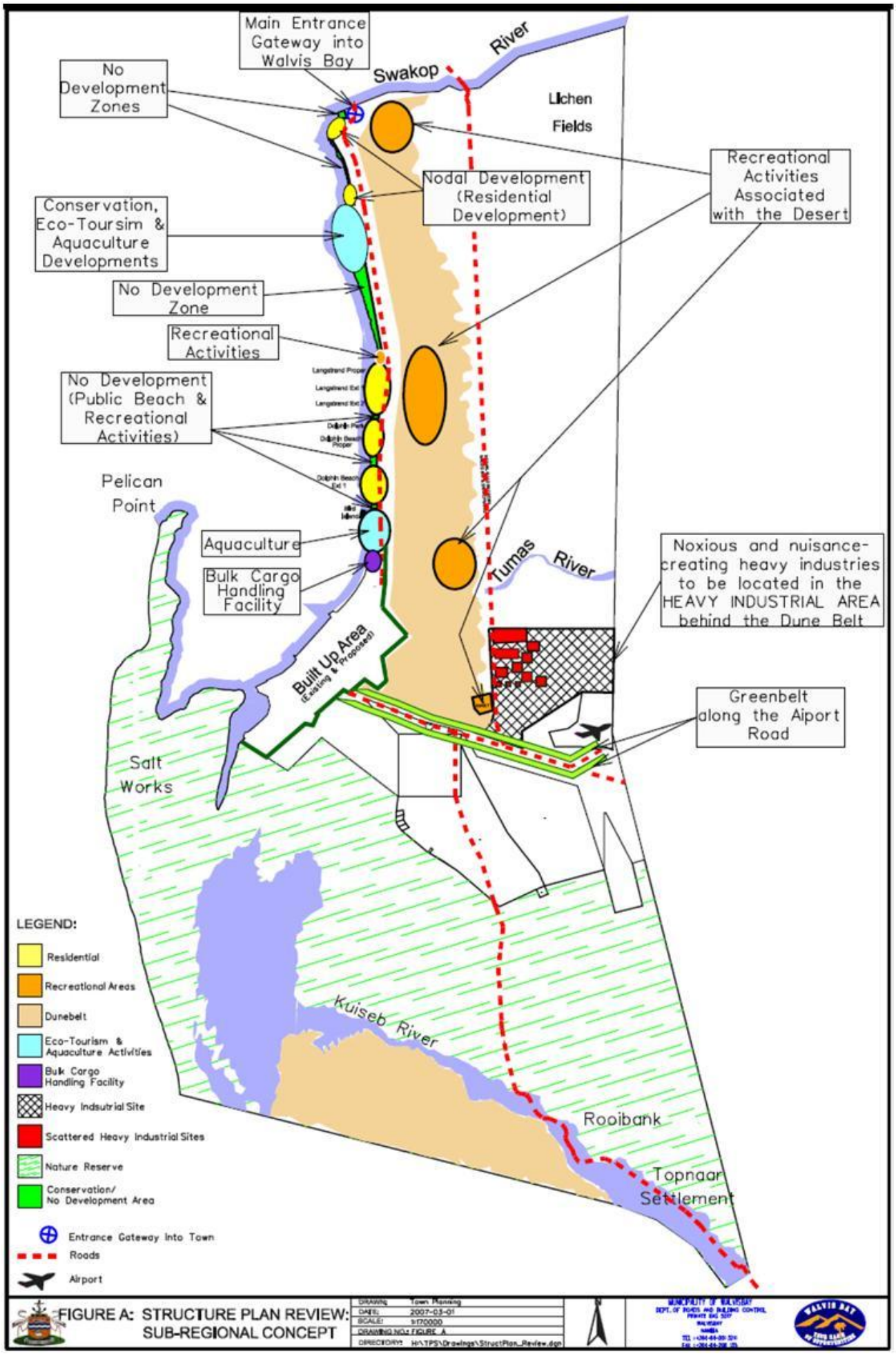


Figure 5.3: Walvis Bay Subregional concept (Source: Walvis Bay Municipality).

6. THE NATURAL ENVIRONMENT AND SPECIALIST STUDIES

6.1 Climatic Settings

The proposed project areas (Kuiseb Delta and Dune Belt Areas) are situated in Walvis Bay, Erongo Region, and in West Central Namibia. Both areas fall within the Namib Desert with daytime hot temperatures throughout the year, while the nights are cold. The mean annual rainfall is very low due to the desert conditions and is less 50 mm (Figs. 6.1- 6.3). Most of the precipitation in the area is in the form of fog. As warm air from the interior of the country meets the cold Benguela current offshore the Namibian coast, condensation causes fog to occur. Fog occurs on average for 65 days per year in this region, mostly during winter, resulting in an equivalent precipitation of 34 mm per annum on average (Fig. 6.4). The fog bank tends to persist offshore and rolls inland during the evening, rarely penetrating more than 20 km inland in this region.

The fauna and flora of the Namib Desert have developed special adaptive systems to use the fog as a source of moisture, in place of rain. Rain is rare and highly variable, with an 80-90% deviation from the annual mean of 15 mm (Figs. 6.1 - 6.3). Most of the rain falls in summer, but it can occur at any time of the year. A fall of over 12 mm is sufficient to cause grass to germinate and lifecycles to be initiated. Generally, the cold Atlantic Ocean Currents modify the temperatures of the desert. Temperatures along the coast are usually cool due to the influence of the cold Benguela current, becoming warmer as one move inland. The average mean temperature in Walvis Bay is around 15º C, with the annual temperature ranging between 5.5 - 36º C (Fig. 6.5). Paradoxically, some of the warmest days in the desert can occur in winter when the hot Berg winds are blowing. The presence of fog causes evaporation at the coast to be much lower than further inland, and humidity to be considerably higher.

Mean annual evaporation around in general study area inclusive of the Kuiseb Delta and Dune Belt areas is around 1, 300 mm, and the annual average humidity is 87%, ranging from lows of 21% during the hot, desiccating Berg winds and 100% when it is foggy. Walvis Bay has an average of 151.5 days in a year with fog or low cloud (Fig. 6.4).

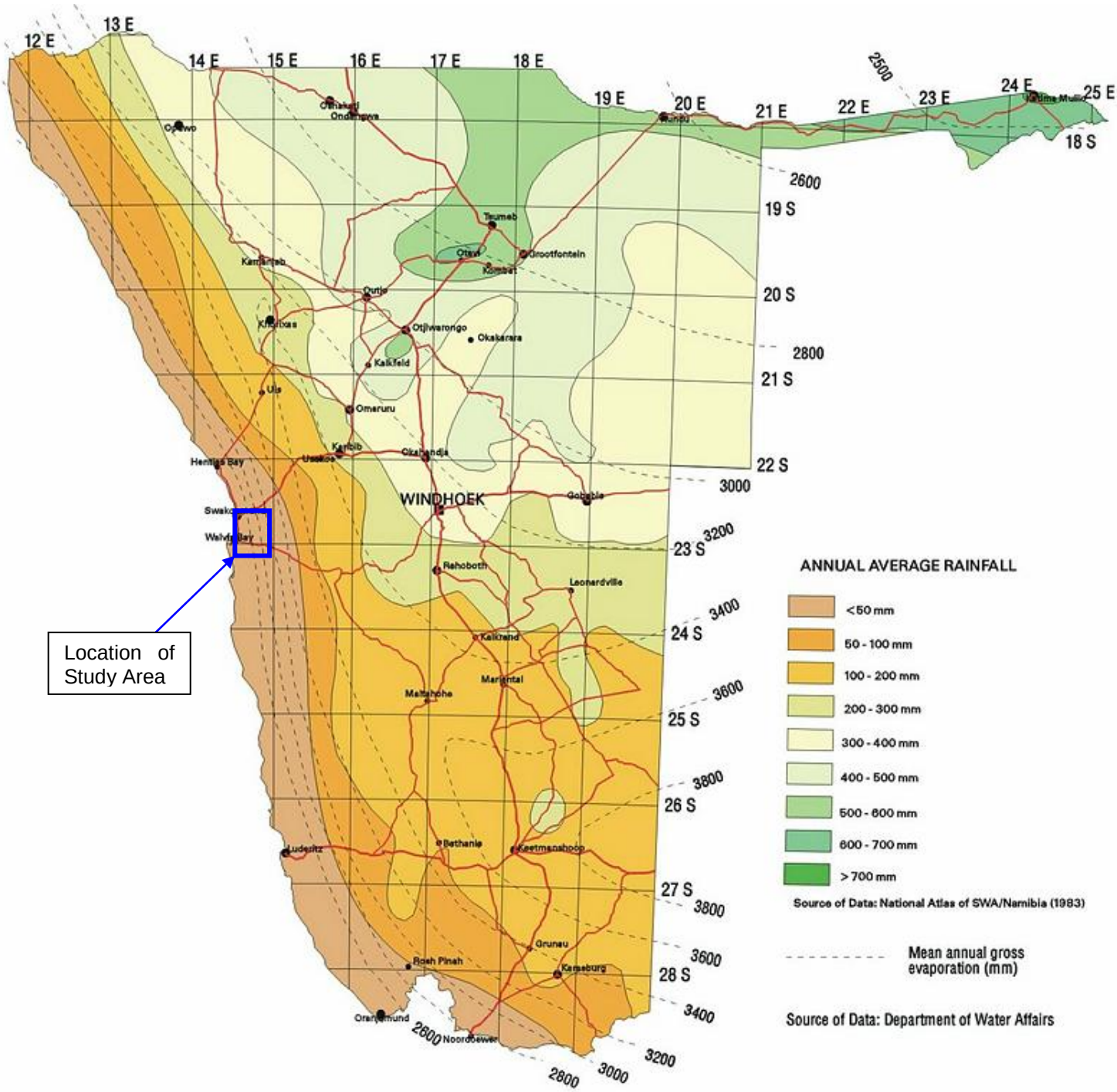


Figure 6.1: Regional climatic setting of Namibia showing the location study area covering the Kuiseb Delta and Dune Belt Areas.

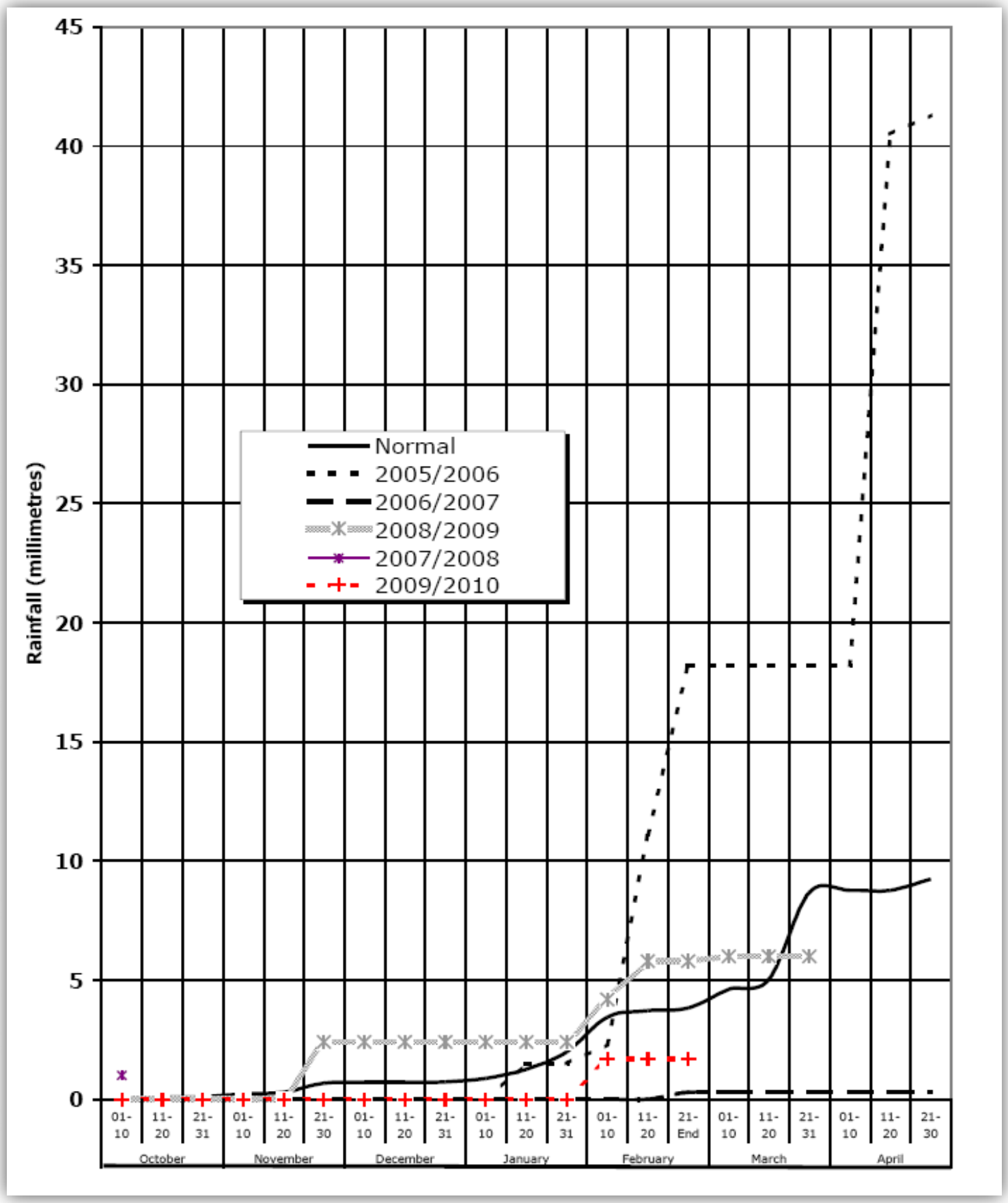


Figure 6.2: Walvis Bay 2009/2010 Seasonal Rainfall Progression Relative to Normal and Previous Seasons (Source: Metrological Services Divisions, 2010).

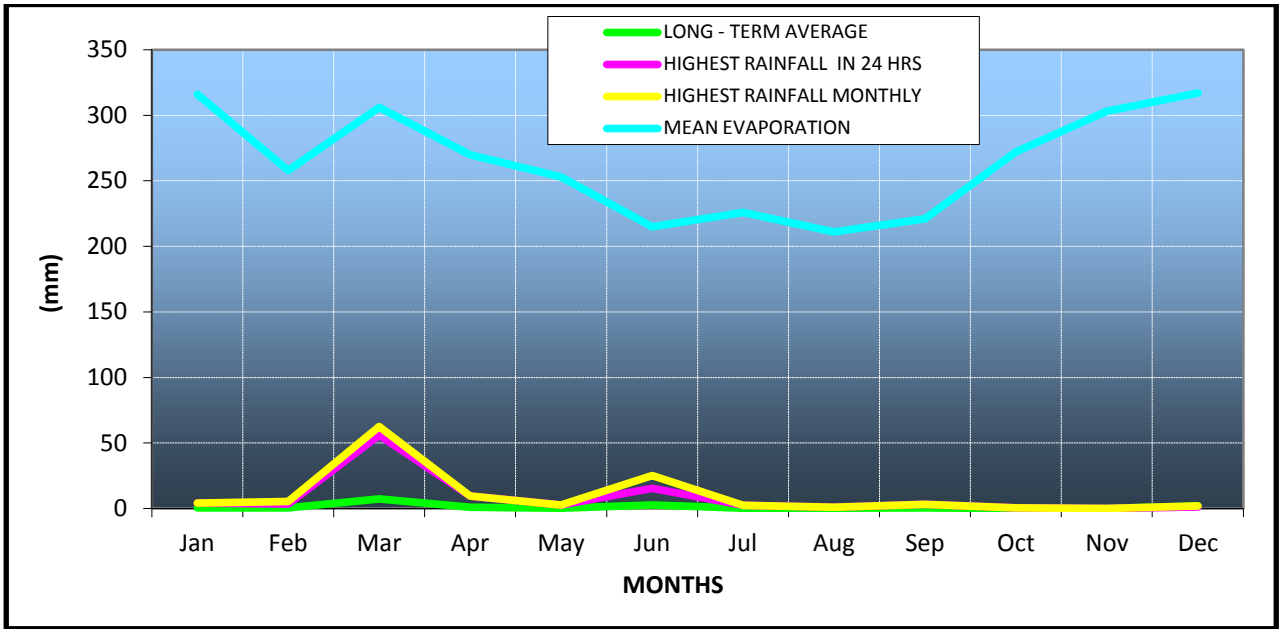


Figure 6.3: Rainfall variation 1958 -2010 based on Walvis Bay Station (Data Source Metrological Services of Namibia).

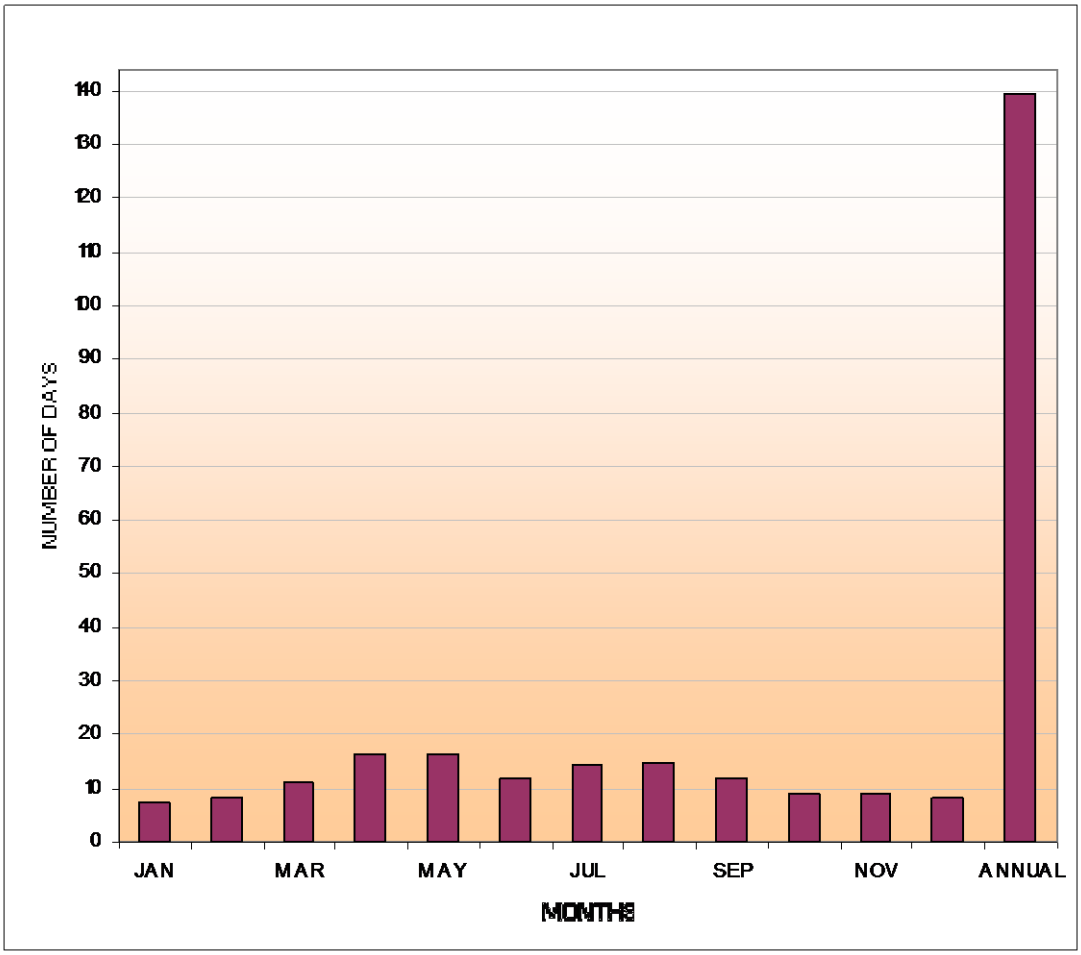


Figure 6.4: Central coast fog events based on Walvis Bay Station (Data Source Metrological Services of Namibia).

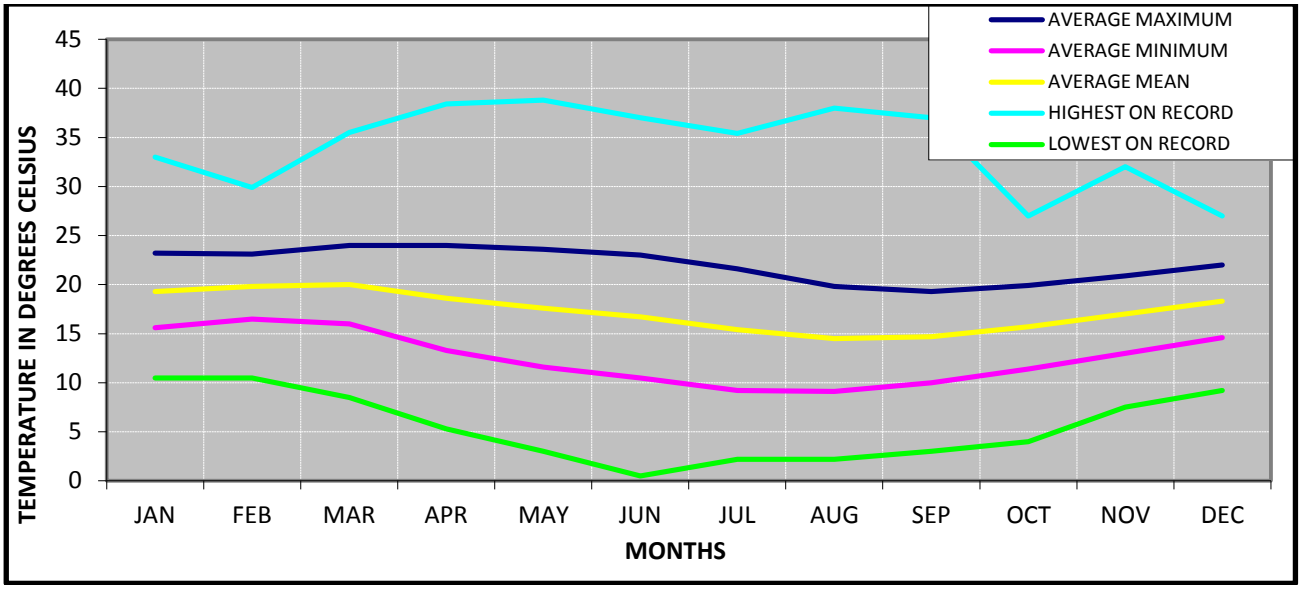


Figure 6.5: Long-term temperature variations 1975 -2010 based on Walvis Bay Station (Data Source Metrological Services of Namibia).

6.1.1 Local and Regional Wind Patterns

Regionally, strong southerly to south-westerly winds persist throughout the year, occasionally giving way to very strong (5-20 m/s) north-easterly 'Berg' winds during the winter months, when sand storms can occur. The prevailing south-westerlies build up through the morning, reaching a peak by late morning, easing again by nightfall (Figs. 6.6 and 6.7). Calm conditions are rare with average wind spends of between 6 – 7 m/s (Fig. 6.7). While the physical manifestations of the wind regime have provided interesting landscapes the practicalities are more prosaic: vehicles have to have special protective coatings to protect the paint work, glass is susceptible to sand blasting, dust affects precision instruments and machinery, and any area stripped of its protective ground cover becomes eroded.

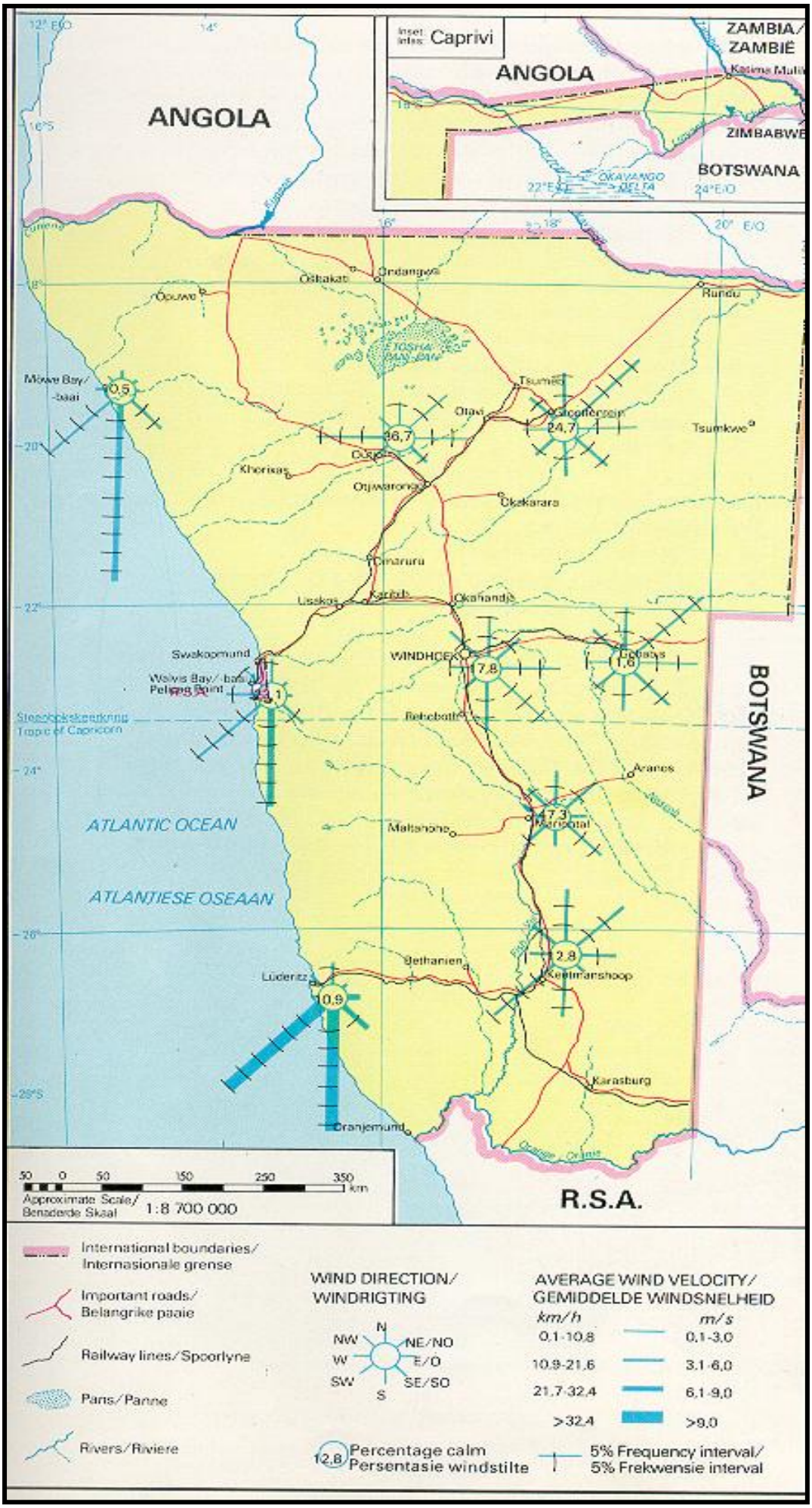


Figure 6.6: Regional wind patterns of Namibia showing Walvis Bay the study area (Source: Metrological Services of Namibia).

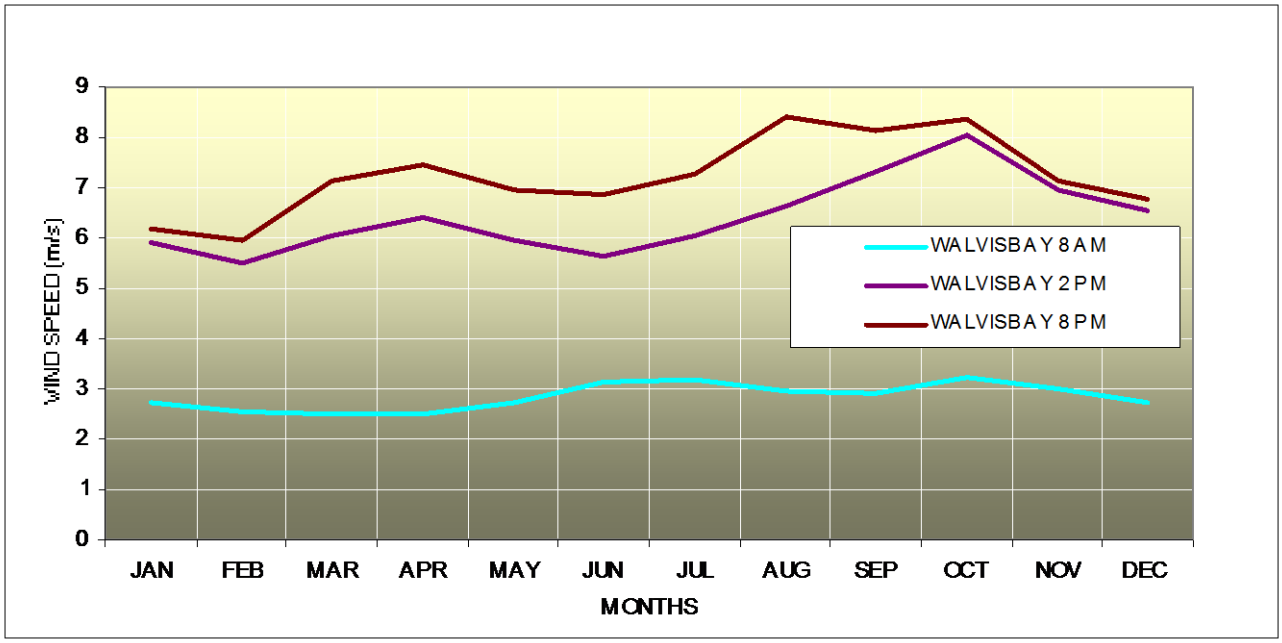


Figure 6.7: Central coast wind speed variations based on Walvis Bay Station (Data Source Metrological Services of Namibia).

6.1.2 Assessment of Climatic Settings

The assessment has been focused on evaluating the likely influences of any climatic components such as the role of wind and dust problems with respect to the proposed project activities. Due to the strong winds, dust will be a major challenge in the area during construction and operational stages. The maintenance cost could be high due to dust effect on the various proposed projects infrastructures and will require regular cleaning. Particulate matter, dust and carbon dioxide are among the general pollutants associated with the role of wind on the construction and operational phases as well as their likely Health, Safety and Environmental (HSE) impacts at local, regional, national and global levels with respect to the proposed projects activities.

Table 6.1: Overall assessment of the climatic influences and air quality impacts.

Description	The influence of the proposed Kuiseb Delta and Dune Belt Projects on the air quality at local, regional, national and global levels will be negligible. The overall contribution of the vehicles to overall emission levels around proposed project areas will be very limited due to the moisture from fog events that will suppress the dust generation activities. However, during windy events dust will be a problem that affects much of the coastal zone of Namibia including the proposed projects areas.
Extent	The extent of any likely impact is assessed as follows: • More than 10 km = 1 (v. low) • 10 km – 5 km = 1 (v. low) • 5 km – 1 km = 1 (v. high) • Less than 1 km = 2 (high) (Occupational Health and Safety - OHS or windy events but Temporal).
Duration	The duration of the likely impacts will be temporal during the construction stage.
Intensity	The level of impacts on the surrounding environment including the associated infrastructure will be minimally. This would include very little contribution to dust, noise and other associated disturbances in the area mainly during the construction stage.
Mitigation	Application of Cleaner Production (CP) and Pollution Prevention (P2) and the adoption of Cleaner Technologies right from the beginning including covered containers, and maintenance of structures and equipment as well as the use of filters on all critical material transfer points and protective clothing will reduce the impact to low. A buffer of more than 500 m from other key environmental resources particularly those of high conservation value.
Frequency of occurrence	Climatic pattern and in particular wind speed and direction as well as operational and management practices will influence the frequency of occurrence during the construction and operational phases.
Probability	Overall probability of influence is as follows: • More than 10 km = 1 (v. low = 0.3) • 10 km – 5 km = 1 (v. low = 0.3) • 5 km – 1 km = 1 (v. low = 0.3) • Less than 1 km = 4 (high) (Occupational Health and Safety - OHS and windy events = 0.6 but temporal).
Significance	Before or without mitigation: **Low** After mitigation: **Very Low to Negligible**
Status of the impact	Negative Localise and mainly OHS and windy events influences on the air quality that may lead to health impacts but will be temporal and localised.
Legal Requirements	Namibia does not have air quality standard but South African standard could be adopted as part of the best practices. The Environmental Impact Assessment Regulations No. 30 of 2012, the Environmental Management Act, 2007, (Act No. 7 of 2007) and Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995) have all been taken into considerations.
Degree of confidence in predictions	90% because the planned activities during construction and operational phases are clear and will be undertaken in an environmentally friendly manners.

6.2 Biodiversity

6.2.1 Vertebrate Fauna Diversity

A field survey was conducted between 23 and 27 July 2011 to determine the vertebrate fauna (e.g. reptiles, amphibians, mammals and birds) and flora in representative areas between the Kuiseb and Swakop Rivers, with the main focus on the dune belt area. The survey was preceded by a comprehensive literature study (i.e. desktop study/scoping report – See Cunningham 2011) conducted between 20 and 24 May 2011 of vertebrate fauna and flora expected to occur in the general area. These surveys are part of an EIA conducted in the general area for NACOMA (Namibian Coast Conservation and Management Project) to assist with future zoning requirements regarding various developments and tourism operations throughout the area.

The central coastal region and the Walvis Bay area in particular, is regarded as "relatively low" in overall (all terrestrial species) diversity (Mendelsohn et al. 2002). Overall terrestrial endemism in the area on the other hand is "moderate to high" (Mendelsohn et al. 2002). Two important coastal wetlands – i.e. Walvis Bay Wetlands and Sandwich Harbour – both Ramsar sites, occur in the area. According to Curtis and Barnard (1998) the entire coast and the Walvis Bay lagoon as a coastal wetland, are viewed as sites with special ecological importance in Namibia. The known distinctive values along the coastline are its biotic richness (arachnids, birds and lichens) with the Walvis Bay lagoon's importance being its biotic richness and migrant shorebirds as well as being the most important Ramsar site in Namibia. It is estimated that at least 54 reptile, 7 amphibian, 42 mammal and 182 bird species (breeding residents) are known to or expected to occur in the general/immediate Walvis Bay/Swakopmund – i.e. Kuiseb River and dune belt – area of which a high proportion are endemics (Cunningham 2011).

The overall plant diversity (all species - "higher" plants) in the general area is estimated at <50 species (Mendelsohn et al. 2002). These estimates are limited to "higher" plants as information regarding "lower" plants is sparse. Burke (2003) estimates that over 400 species – 10% of the flora of Namibia – occur in the central Namib and although it has not been identified as a centre of endemism, it is dominated by endemics such as Arthraerua leubnitziae. Plant endemism is viewed as "medium" – with between 1-15 endemics expected from the general area (Mendelsohn et al. 2002). It is estimated that up to 39 species of larger trees and shrubs and up to 48 grasses are known to or expected to occur in the general/immediate Walvis Bay/Swakopmund – i.e. Kuiseb River and dune belt – area (Cunningham 2011). This field survey was conducted to confirm the vertebrate fauna and flora species at representative sites throughout the area.

6.2.1.1 Vertebrate Fauna Field Survey Methods

6.2.1.1.1 Overview

According to the original ToR, fieldwork to determine the actual faunal diversity would include the following:

- Small mammal transects to determine small mammal diversity in the area;
- Assess larger mammal presence in the area;
- Reptile and amphibian transects (diurnal and nocturnal) to determine reptile and amphibian diversity in the area;

- Bird transects to determine avian diversity in the area.

6.2.1.1.2 Mammals

Small mammal trapping was conducted by active trapping using collapsible aluminium Sherman traps (Plate 6.1) baited with peanut butter and oats. Small mammals caught were identified *in situ*, photographed and released unharmed at the point of capture. A total maximum of 38 traps were placed in various locations approximately 20 to 50 m apart (depending on habitat) for 3 nights each in various habitats viewed as potentially suitable for small mammals in the area as shown in Table 6.2 for trapping site locations. Assessing larger mammals from the area was conducted by traversing representative sites in the area on foot and by vehicle (e.g. Sandwich Harbour area) and included actual sightings, tracks, scats and other signs – e.g. burrows, scrapes, carcasses, etc.

Table 6.2: Small mammal trapping site locations.

Date	Area	Habitat	Co-ordinates	Distance Apart (m)	Traps
24-Jul-11	Western dune face	*Salsola nolothensis* hummocks	22°54'07.1"S 14°32'51.8"E	20	7
24-Jul-11	Kuiseb River	Riparian vegetation	23°09'57.2"S 14°38'25.0"E	20	19
25-Jul-11	Kuiseb River	Riparian vegetation	23°09'21.5"S 14°36'52.7"E	20	19
25-Jul-11	Tumas Drainage	Riparian vegetation	22°54'39.3"S 14°35'38.6"E	20	11
26-Jul-11	Tumas Drainage	Riparian vegetation	22°47'18.1"S 14°34'55.2"E	50	20

Plate 6.1: Sherman collapsible live capture small mammal trap set in *Arthraerua leubnitziae* hummocks in the Tumas drainage line (Photo: Cunningham, 2011).

6.2.1.1.3 Reptiles

Reptile and amphibian transects were conducted during daylight hours although nocturnal observations were not conducted due to the cold weather (less than 15°C) experienced during the survey period. Reptiles, being ectotherms (i.e. "cold blooded"), are inactive with ambient temperatures below 18°C. Transects crisscrossed representative areas and were not conducted in rigid straight lines, but focused on the habitat viewed as most suitable for reptiles and amphibians. Reptiles observed were either caught by hand or by using an active capture technique called 'reptile noosing' where an extendable fishing rod was fitted with a soft thread noose, positioned over the unsuspecting head of an individual and pulled tight. This technique does not result in the death or injury of the caught specimen. Species caught were identified *in situ*, photographed and released unharmed at the point of capture.

6.2.1.1.4 Amphibians

Amphibians were searched for along the Kuiseb River and Tumas drainage lines and other suitable habitat throughout the area whilst searching for reptiles – i.e. no separate transects followed but utilised the same transects to collect as much data on vertebrate fauna (including amphibians) as possible.

6.2.1.1.5 Birds

Bird transects (variable lengths, directions and times) were conducted on foot and by vehicle throughout the area following existing tracks (when in vehicle) during daylight hours using binoculars to identify and confirm species. The annual wetland bird count results were also used to verify birds from the area. The fieldwork was preceded by an extensive literature study of species expected to occur throughout the area while various knowledgeable people were also contacted (i.e. personal communication) regarding certain species expected although not observed during the fieldwork.

6.2.1.2 Vertebrate Fauna Field Survey Results

6.2.1.2.1 Reptile Diversity

The overall reptile diversity and endemism in the general area is estimated at between 31-50 species and 17-24 species, respectively (Mendelsohn *et al.* 2002). Griffin (1998a) presents figures of between 1-20 and 9-10 for endemic lizards and snakes, respectively, from the general central coastal part of Namibia. According to the literature review at least 54 species of reptiles are expected to occur in the general area with 27 species being endemic – i.e. 50% endemic, 1 species (*Varanus albigularis*) as vulnerable, 2 species as rare and insufficiently known while 4 species have some form of international conservation status (Cunningham 2011). During the fieldwork conducted between 23 and 27 July 2011 in the area, 26 species were confirmed of which 14 species were actually observed and 7 species confirmed using the author's personal records and 5 species confirmed by personal communications with various people – e.g. Peter Bridgeford, Naude Dreyer, Mike Griffin, Stuart Hebbard and Joh Henschel.

The species observed and/or confirmed throughout the area included 6 snakes, 9 lizards, 2 chameleons and 9 geckos with examples shown in Plates 6.2 - 6.5. Of these, 14 species are endemic – all "secure" – and 1 species an introduced alien species (Cape Dwarf Chameleon). The two chameleons known to occur in the area (i.e. Cape Dwarf and

Namaqua) are classified as CITES Appendix II species. The endemic species observed and/or confirmed throughout the general area and viewed as the most important are Bitis peringueyi (Péringuey's Adder), Typhlacontias brevipes (FitzSimmons' Burrowing Skink) and various Meroles species. All these species are mainly associated with pockets of vegetation in the dune belt area and susceptible to local disturbances.

It is expected that more species may be located in the general area than observed and/or confirmed during the limited fieldwork and that confirmed sightings should be updated throughout. Table 6.3 indicates the reptile diversity known and/or expected to occur in the general Kuiseb River and dune belt area (literature study only), including species confirmed during the fieldwork (√); the authors personal records from the general area but not observed during the fieldwork (√*) and species confirmed by various people – e.g. Peter Bridgeford[1], Naude Dreyer[2], Mike Griffin[3], Stuart Hebbard[4], Joh Henschel[5] – i.e. personal communications (#).

Table 6.3: Reptile diversity expected and confirmed to occur in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
TURTLES AND TERRAPINS				
Pelomedusa subrufa	Marsh/Helmeted Terrapin		Secure	
SNAKES				
Thread Snakes				
Leptotyphlops occidentalis	Western Thread Snake		Endemic; Secure	SARDB Peripheral
Leptotyphlops labialis	Damara Thread Snake		Endemic; Secure	
Burrowing Snakes				
Xenocalamus bicolour bicolor	Bicoloured Quill-snouted Snake		Secure	
Typical Snakes				
Lamprophis fuliginosus	Brown House Snake		Secure	
Lycophidion capense	Cape Wolf Snake		Secure	
Pseudaspis cana	Mole Snake		Secure	
Dipsina multimaculata	Dwarf Beaked Snake	√*	Endemic; Secure	
Psammophis trigrammus	Western Sand Snake		Endemic; Secure	
Psammophis notostictus	Karoo Sand Snake		Secure	
Psammophis leightoni namibensis	Namib Sand Snake	√	Secure	
Dasypeltis scabra	Common/Rhombic Egg Eater		Secure	
Aspidelaps lubricus infuscatus	Coral Snake		Secure	
Aspidelaps scutatus scutatus	Shield-nose Snake		Secure	
Naya nigricincta	Black-necked Spitting Cobra	#[5]	Endemic; Secure	
Bitis arietans	Puff Adder	#[1,2,4,5]	Secure	
Bitis caudalis	Horned Adder	√	Secure	
Bitis peringueyi	Péringuey's Adder	√	Endemic; Secure	
LIZARDS				
Skinks				
Typhlosaurus braini	Brains's Blind Legless Skink		Endemic; Secure	
Typhlacontias brevipes	FitzSimmons' Burrowing Skink	#[2]	Endemic; Secure	
Trachylepis occidentalis	Western Three-striped Skink		Secure	
Trachylepis striata wahlbergi	Striped Skink		Secure	
Trachylepis sulcata	Western Rock Skink	√*	Secure	
Trachylepis variegata variegata	Variegated Skink		Secure	
Old World Lizards				
Heliobolus lugubris	Bushveld Lizard		Secure	
Meroles anchietae	Shovel-snouted Lizard	√	Secure	
Meroles cuneirostris	Wedge-snouted Desert Lizard	√	Endemic; Secure	
Meroles micropholidotus	Small-scaled Desert Lizard		Endemic; Rare?	
Meroles reticulatus	Reticulated Desert Lizard	√	Endemic; Secure	

Table 6.3: *Cont.*

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International status
Meroles suborbitalis	Spotted Desert Lizard	√*	Secure	
Pedioplanis breviceps	Short-headed Sand Lizard	√*	Endemic; Secure	
Pedioplanis namaquensis	Namaqua Sand Lizard	√*	Secure	
Pedioplanis inornata	Plain Sand Lizard	√*	Endemic; Secure	
Plated Lizards				
Cordylosaurus subtessellatus	Dwarf Plated Lizard		Endemic; Secure	
Monitors				
Varanus albigularis	Rock Monitor		Vulnerable; Peripheral Protected Game	CITES Appendix II Safe to Vulnerable
Agama				
Agama planiceps	Namibian Rock Agama		Secure	
Chameleons				
Bradypodion pumilum	Cape Dwarf Chameleon	#[3]	Introduced alien Secure	CITES Appendix II
Chamaeleo namaquensis	Namaqua Chameleon	√	Secure	CITES Appendix II
Geckos				
Afroedura africana africana	African Flat Gecko		Endemic; Rare?	
Chondrodactylus angulifer namibensis	Giant Ground Gecko	√	Secure	
Narudasia festiva	Festive Gecko		Endemic; Secure	
Pachydactylus bicolour	Velvety Thick-toed Gecko	√	Endemic; Secure	
Pachydactylus kockii	Koch's Thick-toed Gecko		Endemic; Secure	
Pachydactylus turneri	Turner's Thick-toed Gecko	√*	Secure	
Pachydactylus scherzi	Schertz's Thick-toed Gecko		Endemic; Secure	
Pachydactylus rugosus rugosus	Rough Thick-toed Gecko		Endemic; Secure	
Pachydactylus weberi werneri	Weber's Thick-toed Gecko		Endemic; Secure	
Palmatogecko rangei	Wed-footed Gecko	√	Endemic; Secure	
Ptenopus carpi	Carp's Barking Gecko	#[4]	Endemic; Secure	
Ptenopus garrulus maculatus	Common Barking Gecko	√	Secure	
Ptenopus kocki	Kock's Barking Gecko	√	Endemic; Secure	
Rhoptropus afer	Common Namib Day Gecko	√	Endemic; Secure	
Rhoptropus boultoni	Boulton's Namib Day Gecko	√	Endemic; Secure	
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko		Endemic; Secure	

Namibian conservation and legal status according to the Namibian Conservation Ordinance of 1975 (Griffin 2003)
"Endemic" include endemic to South Africa (Branch 1998)
SARDB (South African Red Data Book – reptiles)
Source for literature review: Alexander and Marais (2007), Branch (1998), Branch (2008), Boycott and Bourquin 2000, Broadley (1983), Buys and Buys (1983), Cunningham (2006), Griffin (1998a), Griffin (2003), Hebbard (n.d.), Marais (1992), Tolley and Burger (2007)

Plate 6.2: *Meroles anchietae* (Shovel-snouted Lizard) common in the dune belt area (Photo: Cunningham, 2011).

Plate 6.3: *Meroles reticulatus* (Reticulated Desert Lizard) observed on sandy gravel substrate (Photo: Cunningham, 2011).

Plate 6.4: Tracks of *Typhlacontias brevipes* (FitzSimmons' Burrowing Skink (Photo: Cunningham, 2011).

Plate 6.5: *Chamaeleo namaquensis* (Namaqua Chameleon) (Photo: Cunningham, 2011).

6.2.1.2.2 Amphibian Diversity

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general area is estimated at between 1-3 species. Griffin (1998b) puts the species richness in the general area between 1-2 species. According to the literature review, up to 7 species of amphibians can occur in suitable habitat in the general area (Cunningham 2011). The area is under represented, with 3 toads and 1 species each for rain, rubber and sand frog and platanna known and/or expected (i.e. potentially could be found in the area) to occur in the area. Three species (43%) namely *Poyntonophrynus dombensis*, *Poyntonophrynus hoeschi* and *Phrynomantis annectens* are classified as endemic to Namibia (Griffin 1998b) while all 7 species are classified as "least concern" by the IUCN (IUCN 2010).

The dry sandy coastal desert (Namib) and saline coastal areas are poor habitat for amphibians. Although the ephemeral Kuiseb and Swakop Rivers reach the sea in the Walvis Bay and Swakopmund areas respectively, it seldom flows with temporary freshwater pools being rare close to the coast. Other water bodies in the area are saline of nature and not suitable habitat for amphibians. Gardens in Walvis Bay, Lang Strand and Swakopmund can be suitable habitat and amphibians are known to occur here usually after having being transported from elsewhere (Pers obs.). Overall, the saline coastal habitats are marginal for amphibians. The Kuiseb and Swakop Rivers flooded for lengthy periods during the unusually high 2011 rainy season. This could have resulted in amphibians being transported into the area which otherwise remains generally poor habitat.

Table 6.4 indicates the amphibian diversity known and/or expected to occur in the general Kuiseb River and dune belt area (literature study only). No amphibians were encountered during the fieldwork period.

Table 6.4: Amphibian diversity expected to occur in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	Species: Common name	Status
Toads		
Poyntonophrynus dombensis	Dombe Toad	Endemic
Poyntonophrynus hoeschi	Hoesch's Toad	Endemic
Amietophrynus poweri	Power's Toad or Western Olive Toad	
Rain Frogs		
Breviceps adspersus	Common/Bushveld Rain Frog	
Rubber Frog		
Phrynomantis annectens	Marbled Rubber Frog	Endemic
Bull and Sand Frogs		
Tomopterna tandyi	Tandy's Sand Frog	
Platannas		
Xenopus laevis	Common Platanna	

Source for literature review: Carruthers (2001), Channing (2001), Channing and Griffin (1993), Du Preez and Carruthers (2009), Passmore and Carruthers (1995)

6.2.1.2.3 Mammal Diversity

Table 6.5 indicates the mammal diversity known and/or expected to occur in the general Kuiseb River and dune belt area (literature study only), including species confirmed during the fieldwork (√); the authors personal records from the general area but not observed during the fieldwork (√*) and species confirmed by various people – e.g. Peter Bridgeford[1], Naude Dreyer[2], Stuart Hebbard[3], Joh Henschel[4] – i.e. personal communications (#).

Table 6.5: Mammal diversity expected and confirmed to occur in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International Status
Moles				
Eremitalpa granti	Grant's Golden Mole	#[4]	Endemic; Secure	[1]Vulnerable
Elephant Shrews				
Macroscelides proboscideus flavicaudatus	Round-eared Elephant-shrew	√, #[3]	Endemic; Secure	
Bats				
Lissonycteris angolensis	*Angolan Soft-furred Fruit Bat		Not listed	
Tadarida aegyptiaca	Egyptian Free-tailed Bat		Secure	
Cistugo seabrai	Namibian Wing-gland Bat		Endemic; Rare	[1]Vulnerable; [2]Near Threatened
Laephotis namibensis	Namib Long-eared Bat		Endemic; Insufficiently known	
Nycteris thebaica	Common Slit-faced Bat		Secure	
Rhinolophus clivosus	Geoffroy's Horseshoe Bat		Secure	[1]Near Threatened
Rhinilophus darlingi	Darling's Horseshoe Bat		Secure	[1]Near Threatened
Rhinolophus capensis	*Cape Horseshoe Bat		Secure	[1]Near Threatened; [2]Near Threatened
Taphozous mauritianus	*Mauritanian Tomb Bat		Secure	
Chaerephon ansorgei	*Ansorge's Free-tailed Bat		Not listed	
Sauromys petrophilus	Roberts's Flat-headed Bat		Secure	
Miniopterus natalensis	Natal Long-fingered Bat		Secure	[1]Near Threatened
Eptesicus hottentotus	Long-tailed Serotine		Secure	
Neoromicia zuluensis	*Zulu Serotine		Secure	
Pipistrellus rueppellii	*Rüppell's Pipistrelle		Insufficiently known; Peripheral	
Hares and Rabbits				
Lepus capensis	Cape Hare	√, #[3]	Secure	
Rodents				
Rats and Mice				
Parotomys littledalei namibensis	Littledale's Whistling Rat		Endemic; Secure	[1]Near Threatened
Rhabdomys pumilio	Striped Mouse	√	Secure	
Mus musculus	House Mouse	√*	Invasive alien	
Aethomys chrysophilus	Red Veld Rat		Secure	
Micaelamys (*Aethomys*) *namaquensis*	Namaqua Rock Mouse	√	Secure	
Rattus rattus	House Rat	√*	Invasive alien	
Rattus norvegicus	Brown Rat		Invasive alien	
Desmodillus auricularis	Short-tailed Gerbil		Secure	
Gerbillurus paeba infernus	Hairy-footed Gerbil		Endemic; Insufficiently known	
Gerbillurus tytonis	Dune Hairy-footed Gerbil	√	Endemic; Secure	
Gerbillurus setzeri	Setzer's Hairy-footed Gerbil or Namib Brush-tailed Gerbil		Endemic	
Petromyscus collinus	Pygmy Rock Mouse		Endemic; Secure	
Mastomys coucha	Southern Multimammate Mouse		Secure	
Petromys typicus	Dassie Rat		Endemic; Secure	[1]Near Threatened

Table 6.5: *Cont.*

Species: Scientific name	Species: Common name	Species observed and confirmed	Namibian conservation and legal status	International Status
Carnivores				
Hyaena brunnea	Brown Hyena	√, #[4]	Insufficiently known; Vulnerable? Peripheral	[1]Near Threatened [2]Near Threatened
Crocuta crocuta	Spotted Hyena		Secure? Peripheral	[1]Near Threatened
Felis silvestris	African Wild Cat	√	Vulnerable	CITES Appendix II
Vulpes chama	Cape Fox	√	Vulnerable?	
Canis mesomelas	Black-backed Jackal	√, #[1]	Secure; Problem animal	
Ictonyx striatus	Striped Polecat		Secure	
Suricata suricatta marjoriae	Suricate	√	Endemic; Secure	
Antelopes				
Sylvicapra grimmia	Common Duiker		Secure	
Antidorcas marsupialis	Springbok	√, #[1]	Secure; Huntable game	
Oryx gazella	Gemsbok	√, #[1,2]	Secure; Huntable game	

[1]SARDB (2004); [2]IUCN (2010)
* Unconfirmed bat species although potentially could occur in the area according to habitat modelling (Monadjem *et al.* 2010)
Source for literature review: De Graaff (1981), Griffin (2005), Estes (1995), Joubert and Mostert (1975), Monadjem *et al.* (2010), Skinner and Smithers (1990), Skinner and Chimimba (2005) and Taylor (2000)

The overall mammal diversity in the general area is estimated at between 16-30 species with 3-4 species being endemic (Mendelsohn *et al.* 2002). The overall diversity (1-2 species) and abundance of large herbivorous mammals is "low" in the area with Springbok and Oryx having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall abundance and diversity of large carnivorous mammals is relatively "high" (4 species) in the area with Brown Hyena having the "highest" density of the larger species (Mendelsohn *et al.* 2002). According to the literature review, up to 42 species of mammals are known and/or expected to occur in the general area of which 11 species (29.1%) are classified as endemic (Cunningham 2011).

During the fieldwork conducted between 23 and 27 July 2011 throughout the area, 15 species were confirmed of which 12 species were actually observed and 2 species confirmed using the author's personal records from the general area and 1 species viewed as probably occurring in the Kuiseb River delta dune belt area (J. Henschel *Pers. com.*). Of these, 4 species are viewed as "endemic" albeit "secure" (*Eremitalpa granti*, *Macroscelides proboscideus flavicaudatus*, *Gerbillurus tytonis* and *Suricata suricatta marjoriae*) and 3 species classified as "vulnerable" (*Hyaena brunnea*, *Felis silvestris* and *Vulpes chama*). *Hyaena brunnea* is also classified as "insufficiently known" as well as "near threatened" (Griffin 2005, SARDB 2004, IUCN 2010). *Eremitalpa granti* is classified as "vulnerable" (SARDB 2004) and *Felis silvestris* is listed as a CITES Appendix II species (Griffin 2005). Plates 6.6 - 6.8 as examples of mammals confirmed from the general area during the fieldwork period. Two species – House Mouse and House Rat – are viewed as invasive alien species found in the area.

The small mammal trapping with a potential maximum of 76 rodents (i.e. a maximum of 76 traps set over 3 nights at various locations) resulted in 10 captures (i.e. 13.2% success rate) of 1 species only – Gerbillurus tytonis (Dune Hairy-footed Gerbil; Plate 6.8). One G. tytonis

was trapped in the Kuiseb River riparian vegetation; 4 in the Salsola nolothensis hummocks along the western dune face and 5 in the Tumas drainage line vegetation along the eastern dune face (Fig. 6.8) indicating better trapping success of G. tytonis in the dune belt associated vegetation than the Kuiseb River vegetation. The cold weather encountered during the fieldwork probably contributed to the low capture success.

Although no bats were observed in the area during the fieldwork at least 3 important species – i.e. of conservation concern although not confirmed – are known to occur in the general Kuiseb River area and include *Cistugo seabrai* (Namibian Wing-gland Bat – "endemic & rare"; "vulnerable" & "near threatened"), *Laephotis namibensis* (Namib Long-eared Bat – "endemic & insufficiently known") and *Pipistrellus rueppellii* (Rüppell's Pipistrelle – "Insufficiently known & peripheral").

The most important mammal species known and/or expected to occur in the general area are viewed as the little known bats – i.e. *Cistugo seabrai* and *Laephotis namibensis* – and the carnivores *Hyaena brunnea* (Brown Hyena) and *Felis silvestris* (African Wild Cat). Both carnivores are shy and elusive and tend to avoid disturbed areas. *H. brunnea* are nowhere common throughout their range while *F. silvestris* furthermore faces genetic pollution issues with feral cats close to human settlements.

Oryx have not been seen in the Sandwich Harbour area for a number of years (P. Bridgeford *Pers. com.*) and according to Hebbard (*Pers. com.*), Round-eared Elephant-shrew used to be common on the gravel plains throughout the area, but more recently viewed as uncommon. Spotted Hyena is not known to occur in the area (J. Henschel *Pers. com.*). Other species serendipitously observed in the general area although not indicated in Table 6.5 include Aardvark (Protected Game) and Warthog (Huntable Game) (N. Dreyer *Pers. com.*). Kudu (Huntable Game) have also occasionally been seen in the area (*Pers. obs.*). However, these species probably indicate vagrants having followed the various drainage lines into the area and are not permanently associated with the Kuiseb River and dune belt area. The dune fields between Sandwich Harbour and the Kuiseb River have an extraordinary high abundance of psammophilous arthropods, with an estimated order of magnitude more detritivores than their predators (e.g. wheel spiders, wasps, lizards) (J. Henschel *Pers. com.*).

Although most of the other species of conservation concern are viewed as "secure", overall habitat alteration and overutilization are the two primary processes threatening most mammals in Namibia (Griffin 1998c). Development undoubtedly would affect most mammals in the proposed development area, but by following the proposed mitigations these could be ameliorated.

Plate 6.6: *Hyaena brunnea* (Brown Hyena) faeces observed in the Sandwich Harbour area (Photo: Cunningham, 2011).

Plate 6.7: *Canis mesomelas* (Black-backed Jackal) are numerous throughout the area (Photo: Cunningham, 2011).

Plate 6.8: *Gerbillurus tytonis* (Dune Hairy-footed Gerbil) was the only small mammal trapped during the fieldwork throughout various habitats in the area (Photo: Cunningham, 2011).

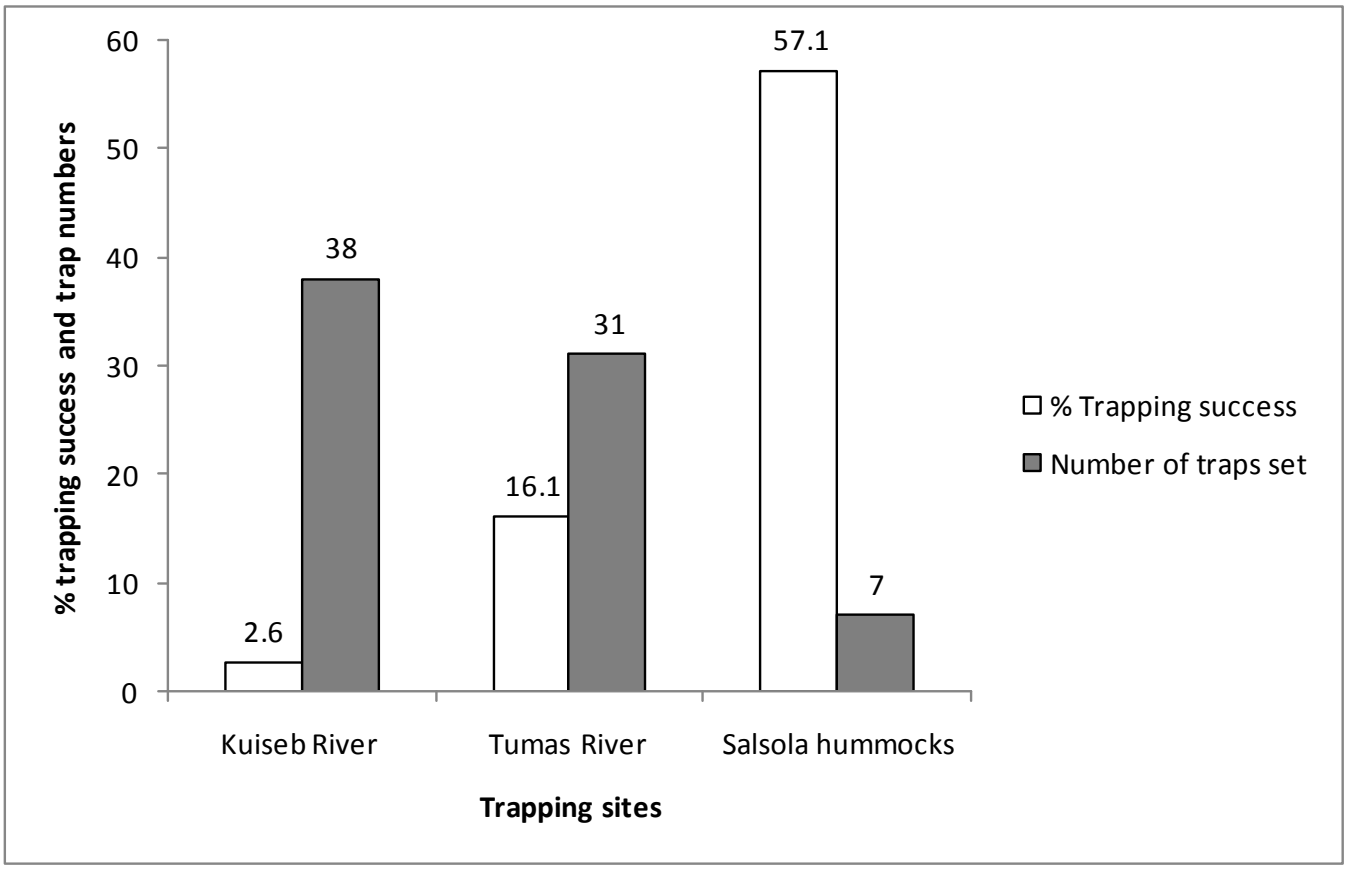


Figure 6.8: Small mammal trapping results – species captured and habitats utilised.

6.2.1.2.4 Avian Diversity

Table 6.6 indicates the bird diversity known and/or expected to occur in the general Kuiseb River and dune belt area (literature study only), including species confirmed during the fieldwork (√); the authors personal records from the general area but not observed during the fieldwork (√*); species confirmed during the 2011 winter wetland bird census during 16 and 17 July 2011 in the Walvis Bay area (#[1]) (See Bridgeford 2011); birds confirmed from the Swakop River area (#[2]) (See Scott and Scott 2008) and personal communication with A. Scott (*Pers. com*.) (#[3]). Table 6.6 excludes migratory birds (e.g. Petrel, Albatross, Skua, etc.) and species breeding extralimital (e.g. stints, sandpipers, etc.) and rather focuses on birds that are breeding residents or can be found in the area during any time of the year. This would imply that many more birds (e.g. Palaearctic migrants) could occur in the area depending on "favourable" environmental conditions.

Bird diversity is viewed as "medium" in the general area with 141-170 species (this would include migrant species) estimated with at least 1 - 3 species being endemic (Mendelsohn *et al.* 2000). According to the literature review, at least 182 species of terrestrial ["breeding residents"] birds occur and/or could occur in the general area at any time although excludes mainly aquatic Palaearctic migrants utilising the general Bay area as an important feeding ground (Cunningham 2011).

Recently published summer (S) and winter (W) bird count from the general area indicate 38 (S) & 30 (W) species (116, 118 [S] & 22, 725 [W] individuals) at Walvis Bay; 24 (S) & 15 (W) species (1, 464 [S] & 499 [W] individuals) at the Walvis Bay sewerage ponds (Plate 6.9; 18 (S) species (134 [S] individuals) at the Swakop River mouth and 34 (S) species (84, 011 [S] individuals) at Sandwich Harbour (Plate 6.10; Bridgeford 2011 [W], Kolberg 2010 [S]). Of these, waders / shorebirds (~50, 000), gulls/terns/skimmers (~30, 000) and grebes (~10, 000) were the most numerous at Walvis Bay indicating the importance of the general area for a variety of birds. According to Bridgeford (2011) the 2011 winter counts were the lowest in the last 5 years – e.g. the second lowest count was during 2009 with 52, 661 and 2, 240 birds at the Bay and sewerage ponds, respectively (Plates 6.9 and 6.10). This could probably be contributed to the above average rains (probably best rains thus far) experienced throughout Namibia during the 2010 / 11 rain season indicating the importance of environmental factors affecting bird distribution and movements.

During the fieldwork conducted between 23 and 27 July 2011 throughout the area, 82 species were confirmed of which 50 species were actually observed, 16 species confirmed using the author's personal records from the general area, 9 species (excluding the author's records) confirmed during the winter 2011 wetland bird count at the Walvis Bay Ramsar site and sewerage works (Bridgeford 2011), 6 species confirmed during a survey of the Swakop River environment (Scott and Scott 2008) and 1 species confirmed through personal communication (Table 6.6, A. Scott *Pers. com.*). Of these, 4 species are viewed as "endemic" (Rüppell's Korhaan, Damara Tern, Dune Lark and Gray's Lark), 1 species "endangered" (Damara Tern), 3 species as "vulnerable" (Greater and Lesser Flamingos and African Black Oystercatcher) and 2 species as "specially protected" (Cape Gannet and Bank Cormorant). Damara Tern and African Black Oystercatcher are also listed as "near threatened" and Cape Gannet as "vulnerable" by the IUCN (2010). However, only Damara Tern, Dune Lark and Gray's Lark are known to breed in the gravel plains in and around the actual dune belt area and consequently viewed as the most important bird species potentially affected by developments in the general dune belt area. Other species also observed in the area but not included in Table 6.6 include Pygmy Falcon (Scott and Scott 2008) and Caspian Tern (*Pers. obs.*).

Table 6.6: Bird diversity expected and confirmed to occur in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Struthio camelus	Common Ostrich	√		
Podiceps cristatus	Great Crested Grebe			
Tachybaptus ruficollis	Little Grebe	√		
Podiceps nigricollis	Black-necked Grebe	√		
Pelecanus onocrotalus	Great White Pelican	√		
Pelecanus rufescens	Pink-backed Pelican			
Phalacrocorax lucidus	White-breasted Cormorant	√		
Morus capensis	Cape Gannet	√	Specially protected	Vulnerable; Breeding endemic
Phalacrocorax capensis	Cape Cormorant	#[1]		Near-threatened; Breeding endemic
Phalacrocorax neglectus	Bank Cormorant	√*	Specially protected	Endemic; Endangered
Phalacrocorax africanus	Reed Cormorant	√		
Phalacrocorax coronatus	Crowned Cormorant			Endemic; Near-threatened
Anhinga melanogaster	Darter			
Ardea cinerea	Grey Heron	√		
Ardea melanocephala	Black-headed Heron	√		
Ardea purpurea	Purple Heron			
Egretta garzetta	Little Egret	#[1]		
Egretta intermedia	Yellow-billed Egret			
Egretta alba	Great Egret			
Egretta ardesiaca	Black Egret			
Bubulcus ibis	Cattle Egret	#[1]		
Ardeola ralloides	Squacco Heron			
Ixobrychus minutes	Little Bittern			
Scopus umbretta	Hamerkop			
Ciconia nigra	Black Stork			
Phoenicopterus ruber	Greater Flamingo	#[1]	Vulnerable	
Phoenicopterus minor	Lesser Flamingo	#[2]	Vulnerable	Near-threatened
Dendrocygna viduata	Whitefaced Duck			
Alopochen aegyptiacus	Egyptian Goose			
Anas capensis	Cape Teal	√		
Anas hottentota	Hottentot Teal			
Anas erythrorhyncha	Redbiled Teal	√		
Anas smithii	Cape Shoveller	#[2]		
Netta erythrophthalma	Southern Pochard	#[1]		
Sagittarius serpentarius	Secretarybird			
Gyps africanus	White-backed Vulture			
Aegypius tracheliotus	Lappet-faced Vulture			
Circaetus pectoralis	Black-chested Snake-Eagle			
Elanus caeruleus	Black-shouldered Kite			
Aquila verreauxii	Verreaux's Eagle			
Aquila rapax	Tawny Eagle			
Polemaetus bellicosus	Martial Eagle			
Buteo augur	Augur Buzzard			
Melierax canorus	Southern Pale Chanting Goshawk	√		Near endemic
Falco peregrinus	Peregrine Falcon			
Falco biarmicus	Lanner Falcon	√*		

Table 6.6: *Cont.*

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Falco chicquera	Red-necked Falcon			
Falco rupicolus	Rock Kestrel	√		
Falco rupicoloides	Greater Kestrel	√*		
Francolinus adspersus	Red-billed Francolin			
Trunix sylvatica	Kurrichane Buttonquail			
Porphyrio porphyrio	African Purple Swamphen			
Gallinula chloropus	Common Moorhen	#[1]		
Fulica cristata	Red-knobbed Coot	√		
Ardeotis kori	Kori Bustard			
Neotis ludwigii	Ludwig's Bustard	#[3]		Endangered; Near endemic
Eupodotis rueppellii	Rüppell's Korhaan	√	Endemic	Near endemic
Eupodotis afra	Black Korhaan			
Actophilornis africanus	African Jacana			
Rostratula benghalensis	Painted Snipe			
Haematopus moquini	African Black Oystercatcher	#[1]	Vulnerable	Near threatened; Endemic
Charadrius marginatus	White-fronted Plover	√*		
Charadrius pallidus	Chestnut-banded Plover	√		Near threatened
Charadrius pecuarius	Kittlitz's Plover	#[1,2]		
Charadrius tricollaris	Three-banded Plover	√		
Vanellus armatus	Blacksmith Lapwing	√		
Recurvirostra avosetta	Pied Avocet			
Himantopus himantopus	Black-winged Stilt	√		
Burhinus capensis	Spotted Thick-knee			
Cursorius rufus	Burchell's Courser	√*		
Rhinoptilus africanus	Double-banded Courser	√		
Larus dominicanus	Kelp Gull	√		
Larus cirrocephalus	Grey-headed Gull			
Larus hartlaubii	Hartlaub's Gull	√		Endemic
Sterna bergii	Swift Tern	√		
Sterna balaenarum	Damara Tern	#[1]	Endemic; Endangered	Near threatened; Breeding endemic
Chlidonias hybridus	Whiskered Tern			
Pterocles namaqua	Namaqua Sandgrouse	√		Near endemic
Pterocles bicinctus	Double-banded Sandgrouse			Near endemic
Columba guinea	Speckled Pigeon	√		
Columba livea	Rock Dove			
Streptopelia capicola	Cape Turtle Dove			
Streptopelia senegalensis	Laughing Dove			
Streptopelia capicola	Cape Turtle-Dove			
Oena capensis	Namaqua Dove	√*		
Agapornis roseicollis	Rosy-faced Lovebird		Endemic	Near endemic
Corythaixoides concolor	Grey Go-away-bird			
Tyto alba	Barn Owl	#[2]		
Otus leucotis	Southern White-faced Scops-Owl			
Glaucidium perlatum	Pearl-spotted Owlet			
Bubo africanus	Spotted Eagle Owl			
Bubo lacteus	Giant Eagle Owl			
Caprimulgus tristigma	Freckled Nightjar			
Apus bradfieldi	Bradfield's Swift			Near endemic

Table 6.6: *Cont.*

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Colius colius	White-backed Mousebird			Endemic
Urocolius indicus	Red-faced Mousebird	#[2]		
Ceryle rudis	Pied Kingfisher	√		
Merops hirundineus	Swallow-tailed Bee-eater	√*		
Upupa epops	Hoopoe	√*		
Phoeniculus cyanomelas	Scimitar-billed Woodhoopoe			
Tockus monteiri	Monteiro's Hornbill		Endemic	
Tockus nasutus	African Grey Hornbill			
Lybius leucomelas	Pied Barbet			
Dendropicos fuscescens	Cardinal Woodpecker			
Mirafra sabota	Sabota Lark	√*		
Mirafra curvirostris	Long-billed Lark			
Calendulauda erythrochlamys	Dune Lark	√	Endemic	Endemic
Chersomanes albofasciata	Spike-heeled Lark	√*		Near endemic
Calandrella cinerea	Red-capped Lark	√*		
Alauda starki	Stark's Lark	√*		Endemic
Ammomanopsis grayi	Gray's Lark	√	Endemic	Near endemic
Certhilauda subcoronata	Karoo Long-billed Lark			Endemic
Eremopterix verticalis	Grey-backed Sparrowlark			Near endemic
Hirundo fuligula	Rock Martin	√		
Riparia paludicola	Brown-throated Martin			
Dicrurus adsimilis	Fork-tailed Drongo	√*		
Corvus capensis	Cape Crow	√		
Corvus albus	Pied Crow	√		
Parus cinerascens	Ashy Tit			Near endemic
Anthoscopus minutes	Cape Penduline Tit			Near endemic
Turdoides bicolour	Pied Babbler			
Pycnonotus nigricans	African Red-eyed Bulbul	√		Near endemic
Monticola brevipes	Short-toed Rock Thrush			
Namibornis herero	Herero Chat		Endemic	Near endemic
Oenanthe monticola	Mountain Wheatear			Near endemic
Cercomela familiaris	Familiar Chat	√*		
Cercomela tractrac	Tractrac Chat	√		Near endemic
Cercomela schlegelii	Karoo Chat			Near endemic
Myrmecocichla formicivora	Ant-eating Chat			Endemic
Erythropygia paena	Kalahari Robin			
Parisoma subcaeruleum	Chestnut-vented Tit-Babbler	√		Near endemic
Parisoma layardi	Layard's Tit-Babbler			Endemic
Zosterops pallidus	Orange River White-eye			Endemic
Sylvietta rufescens	Long-biled Crombec			
Eremomela icteropygialis	Yellow-bellied Eremomela			
Eremomela gregalis	Karoo Eremomela			
Acrocephalus baeticatus	African Reed-Warbler	√		
Acrocephalus gracilirostris	Lesser Swamp-Warbler			
Cisticola aridulus	Desert Cisticola			
Cisticola subruficapilla	Grey-backed Cisticola			Near endemic
Cisticola juncidis	Zitting Cisticola			
Prinia flavicans	Black-chested Prinia	√		

Table 6.6: *Cont.*

Species: Scientific name	Species: Common name	Species observed and confirmed	Status: Namibia	Status: Southern Africa
Melaenornis mariquensis	Marico Flycatcher			Near endemic
Bradornis infuscatus	Chat Flycatcher			Near endemic
Muscicapa striata	Spotted Flycatcher			
Batis pririt	Pririt Batis			Near endemic
Motacilla capensis	Cape Wagtail	√		
Anthus navaeseelandiae	Richard's Pipit			
Anthus similes	Long-billed Pipit			
Anthus vaalensis	Buffy Pipit			
Tchagra australis	Brown-crowned Tchagra			
Lanius collaris	Common Fiscal	#[2]		
Laniarius atrococcineus	Crimson-breasted Shrike			Near endemic
Nilaus afer	Brubru			
Telophorus zeylonus	Bokmakierie	√		Near endemic
Creatophora cinerea	Wattled Starling	√		
Lamprotornis nitens	Cape Glossy Starling	√		
Onychognathus nabouroup	Pale-winged Starling	√		Near endemic
Chalcomitra senegalensis	Scarlet-chested Sunbird			
Nectarinia mariquensis	Marico Sunbird			
Nectarinia fusca	Dusky Sunbird	√		Near endemic
Passer domesticus	House Sparrow	√		
Passer motitensis	Great Sparrow	√		Near endemic
Passer melanurus	Cape Sparrow	#[2]		Near endemic
Passer griseus	Southern Grey-headed Sparrow	√		
Sporopipes squamifrons	Scaly-feathered Finch	√		Near endemic
Plocepasser mahali	White-browed Sparrow-Weaver			
Philetairus socius	Sociable Weaver			Endemic
Ploceus velatus	Southern Masked Weaver	√		
Quelea quelea	Red-billed Quelea			
Euplectes orix	Southern Red Bishop			
Estrilda erythronotos	Black-faced Waxbill			
Estrilda astrild	Common Waxbill	√		
Amadina erythrocephala	Red-headed Finch	√*		Near endemic
Vidua regia	Shaft-tailed Whydah			
Serinus alario	Black-headed Canary			
Serinus flaviventris	Yellow Canary			Near endemic
Crithagra atrogulariis	Black-throated Canary	√*		
Serinus albogularis	White-throated Canary	√		Near endemic
Emberiza capensis	Cape Bunting			Near endemic
Emberiza tahapisi	Cinnamon-breasted Bunting			
Emberiza impetuani	Lark-like Bunting	√		Near endemic

Endangered, vulnerable, near threatened, etc. (IUCN 2010) – status international
Endemic, near endemic (Hockey *et al.* 2006) – status southern Africa
Source for literature review: Bridgeford (2011), Brown *et al.* (1998), Hockey *et al.* (2006), Komen (n.d.), Maclean (1985) and Tarboton (2001).

Plate 6.9: Great White Pelicans and Kelp Gulls observed at the Walvis Bay sewerage works (Photo: Cunningham, 2011).

Plate 6.10: A variety of bird species – e.g. Great White Pelicans, various cormorants, gulls and terns – were observed at the Sandwich Harbour lagoons (Photo: Cunningham, 2011).

6.2.2 Flora Diversity

6.2.2.1 Flora Field Survey Methods

According to the original Terms of Reference (ToR), fieldwork to determine the actual floral diversity was to include the following:

- Trees and shrubs – species composition;
- Grasses – species composition;
- Other species.

6.2.2.2.1 Trees and shrubs

All the trees and shrubs encountered in the general area were identified along various transects crisscrossing the area whilst conducting the fieldwork. The transect directions varied and depended on the terrain. All the different habitats were incorporated in the representative areas surveyed.

6.2.2.2.2 Grasses

All the grasses encountered in the general area were identified along various transects crisscrossing the area whilst conducting the fieldwork. The transect directions varied and depended on the terrain. All the different habitats were incorporated in the representative areas surveyed.

6.2.2.2.3 Other species

Other species – i.e. herbs, lichens, etc. were also identified whenever encountered.

6.2.2.2 Flora Field Survey Results

6.2.2.2.1 Tree and Shrub Diversity

The trees and shrubs known and/or expected to occur in the general central coastal Namibia area (literature used includes: Burke 2003, Curtis and Mannheimer 2005, Craven and Marais 1986 and Mannheimer and Curtis 2009), including species actually observed (or confirmed) during the fieldwork conducted between 23 and 27 July 2011 (√), is presented in Table 6.7. According to Curtis and Mannheimer (2005) and Mannheimer and Curtis (2009) between 26 and 39 species of larger trees and shrubs are known and/or expected to occur in the general area of which 6 species are classified as endemic (i.e. 15.4%). Scott and Scott (2008) identified 17 species of plants (including grasses) during a survey along the Swakop River which forms the northern boundary of the study site as assessed during this study.

During the fieldwork, only 9 species of larger trees/shrubs – 3 species protected by Forestry and 1 species being endemic (Arthraerua leubnitziae) – were confirmed from the general area – with most of these mainly associated with the Kuiseb River riparian vegetation (Table 6.7).

A total of 33 species of plants (including lichens, but excluding grasses) were identified in various habitats throughout the area with the majority of the flora diversity associated with the Kuiseb (16 species) and Tumas (13 species) Rivers, respectively, followed by the northern lichen dominated gravel plains (10 species) (Table 6.7).

The presence of plants is however dependent on environmental conditions, especially rainfall, implying that many more species are expected to occur throughout the area than presented in Table 6.7. Vegetation should be collected over various seasons to obtain the full potential spectrum occurring in an area. Species indicated in Table 6.7 should be viewed as a “snapshot” in time as encountered during the fieldwork during late July 2011.

Table 6.8 indicates flora (including lichens, but excluding grass) observed in various habitats throughout the area.

Table 6.7: Tree/shrub diversity expected and confirmed to occur in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	**Expected:** Curtis and Mannheimer (2005)	**Expected:** Mannheimer and Curtis (2009)	**Expected:** Burke (2003)	**Expected:** Craven and Marais (1986)	**Species observed and confirmed**	**Status**
Acacia erioloba	√	√	√	√	√	Protected (F)
Acacia reficiens	√	√		√		
Acacia tortilis	√	√				
Acanthosicyos horridus	√	√	√	√	√	Protected (F)
Adenia pechuelii	√					Endemic
Adenolobus garipensis	√	√	√			
Adenolobus pechuelii			√	√		
Aloe asperifolia				√		
Aloe dichotoma	√					NC, C2
Aptosimum spinescens			√			
Arthraerua leubnitziae			√	√	√	Endemic
Asclepias buchenaviana				√		
Barleria lancifolia			√			
Boscia foetida	√		√			
Cadaba aphylla	√					
Calicorema capitata			√			
Combretum imberbe	√	√				Protected (F)
Commiphora dinteri	√					Endemic
Commiphora glaucescens	√		√			
Commiphora oblanceolata	√					
Commiphora saxicola	√		√	√		Endemic
Commiphora tenuipetiolata	√					
Commiphora virgata	√					Endemic
Commiphora wildii	√	√				
Cordia sinensis		√				
Cyphostemma currorii			√			
Dyerophytum africcanum			√			
Euclea pseudebenus	√	√	√	√		Protected (F)
Euphorbia damarana	√					Endemic, C2
Euphorbia guerichiana	√					C2
Euphorbia virosa	√		√			C2
Faidherbia albida	√	√		√	√	Protected (F)
Ficus cordata		√				Protected (F)
Ficus sycomorus	√	√				Protected (F)
Grewia tenax	√	√				
Gymnosporia senegalensis	√					
Hoodia currorii			√	√		
Hyphaene petersiana	√					
Ipomoea adenioides				√		
Lycium bosciifolium	√	√				
Lycium cinereum	√	√		√		
Lycium hirsutum	√	√				
Lycium pumilum		√				
Lycium tetrandrum		√			√	
Maerua juncea	√					
Maerua schinzii	√		√			Protected (F)
Monechma cleomoides			√			
Moringa ovalifolia			√			
Parkinsonia africana	√	√		√		Protected (F)
Pechuel-Loeschea leubnitziae		√		√	√	
Petalidium setosum			√	√		
Rhus marlothii	√					

Table 6.7: *Cont.*

Species: Scientific name	**Expected:** Curtis and Mannheimer (2005)	**Expected:** Mannheimer and Curtis (2009)	**Expected:** Burke (2003)	**Expected:** Craven and Marais (1986)	**Species observed and confirmed**	**Status**
Salsola sp.	√	√	√	√	√	
S. arborea, *S. aphylla*, *S. nollothensis*						
Salvadora persica	√	√	√	√		
Sarcocaulon marlothii				√		
Searsia marlothii		√				
Tamarix usneoides	√	√	√	√	√	Protected (F)
Tetragonia reduplicata				√		
Welwitschia mirabilis	√	√	√	√		NC, C2
Zygophyllum stapffii		√		√	√	

Endemic (Craven 1999)
F – Forestry Ordinance No. 37 of 1952 and/or Forest Act No. 72 of 1968 (Curtis and Mannheimer 2005, Mannheimer and Curtis 2009)
NC – Nature Conservation Ordinance No. 4 of 1975 (Curtis and Mannheimer 2005, Mannheimer and Curtis 2009)
C2 – CITES Appendix 2 (Curtis and Mannheimer 2005, Mannheimer and Curtis 2009).

Table 6.8: Flora (including lichens, but excluding grass) observed in various habitats in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	**Kuiseb River***	**Tumas River**	**Sandwich Area**	**Dunes: West**	**Dunes: East**	**Rocky Outcrops**	**Gravel Plains: General**	**Gravel Plains: North**	**SW**	**Status**
Acacia erioloba	√									Protected (F)
Acanthosicyos horridus	√	√			√					Protected (F)
Arthraerua leubnitziae		√				√	√	√		Endemic[1]
Brownanthus arenosus					√			√		Near Endemic
Buellia stellulata		√				√		√		
Caloplaca elegantissima								√		Endemic[2]
Caloplaca volkii								√		Endemic[2]
Caparis hereoensis			√		√					
Citrullus lanatus	√									
Cyperus marginatus			√	√	√					
Faidherbia albida	√									Protected (F)
Felicia smaragdina		√								
Galenia africana	√	√								
Geigeria sp.	√									
Gossypium anomalum	√									
Heliotropium sp.		√				√				
Lycium tetrandrum	√									
Mesembryanthemum cryptanthum	√				√	√	√	√		
Mesembryanthemum guerichianum	√	√				√	√			
Myxopappus hereroensis							√			
Ornithogalum sp.						√				
Pechuel-Loeschea leubnitziae	√									
Salsola sp.	√	√	√	√	√					
S. arborea, *S. aphylla*, *S. nollothensis*										
Sarcocornia perennis			√							
Saueda sp.			√							
Senecio engleranus	√									
Tamarix usneoides	√	√			√				√	Protected (F)
Trianthema hereroensis							√			
Xanthodactylon turbinatum		√								
Xanthoparmelia namibiensis								√		
Xanthoparmelia walteri		√						√		
Zygophyllum simplex	√	√				√	√	√		
Zygophyllum stapffii	√	√				√	√	√		

SW – Sewerage Works
Endemic ([1]Craven 1999, [2]Wirth 2010)
Near Endemic (Mannheimer *et al.* (2008)
F – Forestry Ordinance No. 37 of 1952 and/or Forest Act No. 72 of 1968 (Curtis and Mannheimer 2005, Mannheimer and Curtis 2009)
*The Kuiseb River habitat includes the delta area

6.2.2.2.2 Grass Diversity

The grasses known and/or expected to occur in the general central coastal Namibia, area (literature used includes: Burke 2003, Curtis and Marais 1986, Müller 2007, Müller 1984, Van Oudshoorn 1999), including species actually observed (or confirmed) during the fieldwork conducted between 23 and 27 July 2011 (√), is presented in Table 6.9.

According to various authors up to 48 grasses – 6 to 37 species – occur in the general central coastal, Namibia area. More specifically, between 21 and 24 species of grass potentially could occur in the general area (Müller 1984, Müller 2007).

During the fieldwork, only 9 species of grass were confirmed from the general area as indicated to occur in the area (Table 6.9). Two more grass species – not included in Table 6.9 above – observed in the area included *Cladoraphis cyperoides* and *Stipagrostis hermanii* (Table 6.10).

Grasses are not well represented throughout the dune belt area with only 8 species observed and the annual *S. hermanii* probably the most widespread, especially on the gravel and sandy/gravel plains, while *S. sabulicolia* is common on hummocks along the Kuiseb River. *Phragmites australis* forms dense stands in the Kuiseb River delta area as well as the Walvis Bay sewerage works. *Odyssea paucinervis* is the most common grass adjacent the lagoons in the Sandwich Harbour area.

Table 6.9: Indicates grasses observed in various habitats throughout the area.

Species: Scientific name	Species observed and confirmed	Status	Ecological Status	Grazing Value
[2,5]*Anthephora pubescens*			Decreaser	High
[2]*Aristida adscensionis*			Increaser 2	Low
[2]*Aristida congesta*			Increaser 2	Low
[2,5]*Bachiaria deflexa*			Increaser 2	Average
[2,3]*Cenchrus ciliaris*			Decreaser	High
[1,2,3]*Centropodia glauca*			Decreaser	High
[1,2]*Chloris virgata*			Increaser 2	Average
[2,4]*Cladoraphis spinosa*	√		Increaser 1	Average
[1,2,5]*Cynodon dactylon*	√		Increaser 2	High
[1,2]*Dactyloctenium aegyptium*			Increaser 2	Average
[1,2]*Enneapogon cenchroides*			Increaser 2	Low
[1,2,3]*Enneapogon desvauxii*			Intermediate	Average
[1,2]*Enneapogon scaber*			?	Low
[2]*Enneapogon scoparius*			Increaser 2	Low
[1,5]*Entoplocamia aristulata*			Intermediate	Low
[1,5]*Eragrostis annulata*			Increaser 2	Low
[2]*Eragrostis cilianensis*			Increaser 2	Low
[1,2,5]*Eragrostis echinochloidea*			Increaser 2	Average
[2]*Eragrostis lehmanniana*			Increaser 2	Average
[2,3,5]*Eragrostis nindensis*			Increaser 2	Average
[1]*Eragrostis omahekensis*		Endemic	?	Low
[1,5]*Eragrostis porosa*			Intermediate	Low
[2]*Eragrostis rotifer*			Intermediate	Low
[2,5]*Eragrostis superba*			Increaser 2	Average
[2,5]*Fingerhuthia africana*			Decreaser	Average
[2]*Melinis repens*			Increaser 2	Low
[1,4,5]*Odyssea paucinervis*	√		?	Low
[2,5]*Panicum repens*			Decreaser	High
[2,4]*Phragmites australis*	√		Decreaser	Low
[1,5]*Pogonarthria fleckii*			Increaser 2	Low
[2]*Polypogon monspeliensis*			?	Average
[2]*Schmidtia kalahariensis*			Increaser 2	Low
[1,2]*Schmidtia pappophoroides*			Decreaser	High
[1]*Setaria appendiculata*			Decreaser	High
[2]*Setaria megaphylla*			Decreaser	High
[1,2]*Setaria verticillata*			Increaser 2	Average
[4]*Sporobolus consimilis*			?	Low
[2]*Sporobolus festivus*			Increaser 2	Low
[4]*Sporobolus nebulosus*			Increaser 2	Low
[1,2,3,5]*Stipagrostis ciliata*			Decreaser	High
[1,2,5]*Stipagrostis hirtigluma*	√		Increaser 2	Low
[1,5]*Stipagrostis hochstetteriana*			Decreaser	Average
[1,2,5]*Stipagrostis namaquensis*			?	Average
[3]*Stipagrostis sabulicolia*	√	Endemic*	?	?
[1,2,5]*Stipagrostis obtusa*			Decreaser	High
[1,2,5]*Stipagrostis uniplumis*	√		Increaser 2	Average
[1,2,5]*Tricholaena monachne*			Increaser 2	Average
[2,5]*Tragus berteronianus*			Increaser 2	Low

Endemic - Müller (1984); **Endemic*** - Burke (2003)
? – Undetermined in literature

Table 6.10: Grass diversity expected and confirmed to occur in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	Kuiseb River*	Tumas River	Sandwich Area	Dunes: West	Dunes: East	Rocky Outcrops	Gravel Plains: General	Gravel Plains: North	SW	Status
Cladoraphis cyperoides			√		√					
Cladoraphis spinosa	√		√				√			
Cynodon dactylon[#]							√			
Odyssea paucinervis			√		√		√			
Phragmites australis			√		√				√	
Stipagrotis hermanii		√		√			√	√		
Stipagrostis hirtigluma						√	√			
Stipagrostis sabulicolia	√				√					Endemic
Stipagrostis uniplumis		√				√				

SW – Sewerage Works
Endemic - Burke (2003)
*The Kuiseb River habitat includes the delta area
[#]*Cynodon dactylon* observed at artificial water point east of the dunes

6.2.2.2.3 Habitats

Although the general area is typical of the Southern Namib or Southern Desert (Giess 1971, Mendelsohn *et al.* 2002, van der Merwe 1983) the various habitats within the Kuiseb River and dune belt area differ remarkably (Plates 6.11 – 6.22). Plates 6.11 - 6.22 attempt to indicate the obvious flora differences visually. The actual dune belt area between the Kuiseb and Swakop Rivers is virtually devoid of vegetation throughout although patches of Arthraerua leubnitziae occur in inter-dune gravel patches (Plate 6.19). This dune field is however the northernmost distribution of many species otherwise confined to the great dune sea south of the Kuiseb River (J. Henschel Pers. com.). However, the dune belt between Sandwich Harbour and the Kuiseb River is better vegetated with patches of Acanthosicyos horridus and Caparis herereonisis (Plate 6.20).

Plate 6.11: The Kuiseb River riparian vegetation is dominated by *Acacia erioloba* and *Faidherbia albida* trees, *Zygophyllum stapffii* shrubs and a variety of invasive alien species (Photo: Cunningham, 2011).

Plate 6.12: The Tumas River is dominated by *Salsola nollothensis* shrubs on hummocks and prostrate *Zygophyllum simplex (Photo: Cunningham, 2011).*

Plate 6.13: The Sandwich Harbour area is dominated by *Odyssea paucinervis* grass and *Phragmites australis* reeds, *Sarcocornia perennis* adjacent the lagoons with the hummocks covered by *Acanthosicyos horridus* and *Caparis herereonisis* (Photo: Cunningham, 2011).

Plate 6.14: Gravel plains dominated by the annual *Stipagrostis hermanii* with *Salsola nollothensis* hummocks in the background typical of the habitat along the western edge of the dune belt (Photo: Cunningham, 2011).

Plate 6.15: Sandy gravel plains with patches of *Arthraerua leubnitziae* hummocks are typical along the eastern edge of the dune belt (Photo: Cunningham, 2011).

Plate 6.16: Sparsely vegetated rocky outcrops in the area (Photo: Cunningham, 2011).

Plate 6.17: Sparsely vegetated gravel plains between the Kuiseb River and the dune belt area (Photo: Cunningham, 2011).

Plate 6.18: The northern gravel plains on the eastern edge of the dune belt towards the Swakop River are covered by lichens (e.g. mostly *Caloplaca elegantissima*) and the prostrate *Zygophyllum simplex* with *Arthraerua leubnitziae* mainly associated along the drainage lines (Photo: Cunningham, 2011).

Plate 6.19: Sparsely vegetated dune belt area between the Kuiseb and Swakop Rivers (Photo: Cunningham, 2011).

Plate 6.20: Patches of *Acanthosicyos horridus* and *Caparis herereonisis* in dune hollows in the dune belt area between Sandwich Harbour and the Kuiseb River (Photo: Cunningham, 2011).

Plate 6.21: Coastal dune hummocks in the Paaltjies area are mainly dominated by *Salsola nollothensis*, but also *Capparis hereoensis* and *Lycium tetrandrum* shrubs and generally have a high abundance of invertebrates – e.g. Black Widow spiders feeding on other satellite fauna (J. Henschel *Pers. com.*) and vertebrates – e.g. *Meroles* species lizards and gerbils (Photo: Cunningham, 2011).

Plate 6.22: *Phragmites australis* and *Tamarix usneoides* are dominant at the Walvis Bay Sewerage Works (Photo: Cunningham, 2011).

6.2.2.2.4 Alien Species

Twelve invasive alien plant species (Plate 6.23 – 6.25) were observed throughout the area with the Kuiseb River being heavily infested (Table 6.11). Except for a *Sisal* sp. specimen observed on one of the rocky outcrops in the Rooibank area as well as *Opuntia* sp. and *Ricinus communis* at seepage at an artificial source – i.e. water pipeline – east of the dunes, no other invasive aliens were observed in any of the other habitats. *Eucalyptus* sp. was also only observed in the Kuiseb River delta area. Scott and Scott (2008) confirmed 2 species of invasive alien species (Nicotiana glauca and Prosopis sp.) occurring in the Swakop River as observed during a survey of the river and environments. Although the Swakop River forms the northern boundary of the proposed survey site (this study) and not included during this study, I have included these sightings here as technically they could spread into the survey area.

Table 6.11: Alien species observed in various habitats in the general Kuiseb delta and dune belt area – i.e. Walvis Bay and Swakopmund areas.

Species: Scientific name	Kuiseb River*	Tumas River	Sandwich Area	Dunes: West	Dunes: East	Rocky Outcrops	Gravel Plains: General	Gravel Plains: North
Argemone ochroleuca	√							
Datura ferox	√							
Datura innoxia	√							
Eucalyptus sp.	√							
Nicotiana glauca	√							
Opuntia sp.#					√			
Pennesetum clandestinum#					√			
Prosopis sp.	√							
Ricinus communis	√				√			
Sesbania bispinosa	√							
Sisal sp.						√		
Verbesina encelloides	√							

*The Kuiseb River habitat includes the delta area
#Opuntia sp. and Pennesetum clandestinum found at artificial water point – leakage – east of the dunes

Plate 6.23: Dense stands of invasive aliens – *Argemone ochroleuca*, *Datura* sp., *Nicotiana glauca* and *Ricinus communis* – occur in the Kuiseb River (Photo: Cunningham, 2011).

Plate 6.24: *Eucalyptus* sp. observed in the Kuiseb River delta area (Photo: Cunningham, 2011).

Plate 6.25: *Sisal* sp. individual encountered in a rocky outcrop in the Rooibank area (Photo: Cunningham, 2011).

6.2.3 Vertebrate Fauna and Flora Conclusions

6.2.3.1 Vertebrate Fauna Conclusions

It is estimated that at least 54 reptile, 7 amphibian, 42 mammal and 182 bird species (breeding residents) are known to or expected to occur in the general area of which a large proportion are endemics. Endemics include at least 50% of the reptiles, 43% of the amphibians, 29% of the mammals and 4% (7 of the 14 Namibian endemics) of all the breeding and/or resident birds known and/or expected to occur in the general area. During the fieldwork conducted between 23 and 27 July 2011, 26 reptiles, 0 amphibians, 15 mammals and 82 bird species were identified and confirmed (See Appendix 1).

6.2.3.1.1 Reptiles

The high percentage of endemic reptile species (50%) known and/or expected to occur in the general area underscores the importance of this area for reptiles. Reptile species of concern are the 2 thread snakes (*Leptotyphlops occidentalis* and *L. labialis*) as well as the sand burrowing/dwelling species such as *Bitis peringueyi* and the various *Meroles* species, especially *Meroles micropholidotus* classified as endemic and rare, as well as the high proportion (81%) of endemic gecko (e.g. *Pachydactylus* species) species of which very little is known about their ecological role and actual status in Namibia. The seemingly barren sandy dune and gravel plain areas are host to a variety of reptile fauna not often expected and/or acknowledged. Fig. 6.9 shows DST of important reptiles sensitive area based on the results of the flora specialist work undertaken for this project. Poorly planned and executed development and recreation activities could affect these species negatively.

6.2.3.1.2 Amphibians

Amphibians are generally not viewed as extremely important in saline coastal areas which are marginal habitat for most amphibians. Although 43% of the amphibians expected to occur in the general area are endemic to Namibia they are expected to occur further inland – i.e. the Kuiseb and Swakop Rivers and rocky outcrops with temporary pools associated with these landforms, etc. – and not directly associated with the dune belt between Walvis Bay and Swakopmund. The endemic *Phrynomantis annectens* is probably the amphibian of greatest concern in the area although it occurs widespread throughout large parts of Namibia.

6.2.3.1.3 Mammals

Endemic mammals expected to occur in the general area make up a relatively large percentage (29%) of the mammals known and/or expected from the area. Endemic mammal species of concern include the mole *Eremitalpa granti* and the two bats *Laephotis namibensis* and *Cistugo seabrai* as well as the Hairy-footed Gerbils (*Gerbillurus* sp.). Both bats are very poorly known with only a few records from the general area making them particularly important. Fig. 6.10 summarises important reptiles sensitive area based on the results of the flora specialist work undertaken for this project. The predator of concern is *Hyaena brunnea* which is classified locally as Insufficiently Known, probably Vulnerable; with an international status of Vulnerable (SARDB 2004, IUCN 2010).

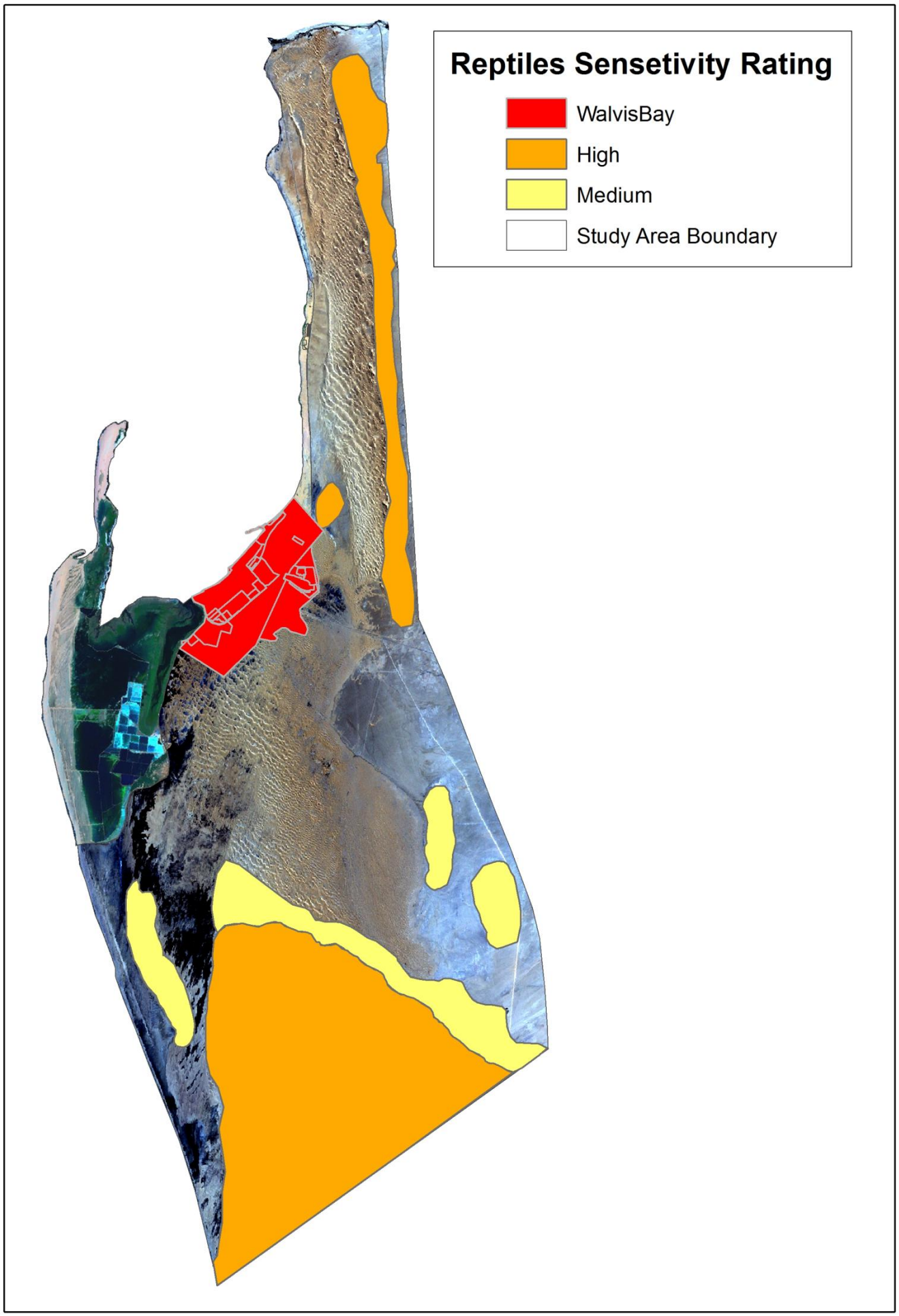


Figure 6.9: DST of important reptiles sensitive area based on the results of the flora specialist work undertaken for this project.

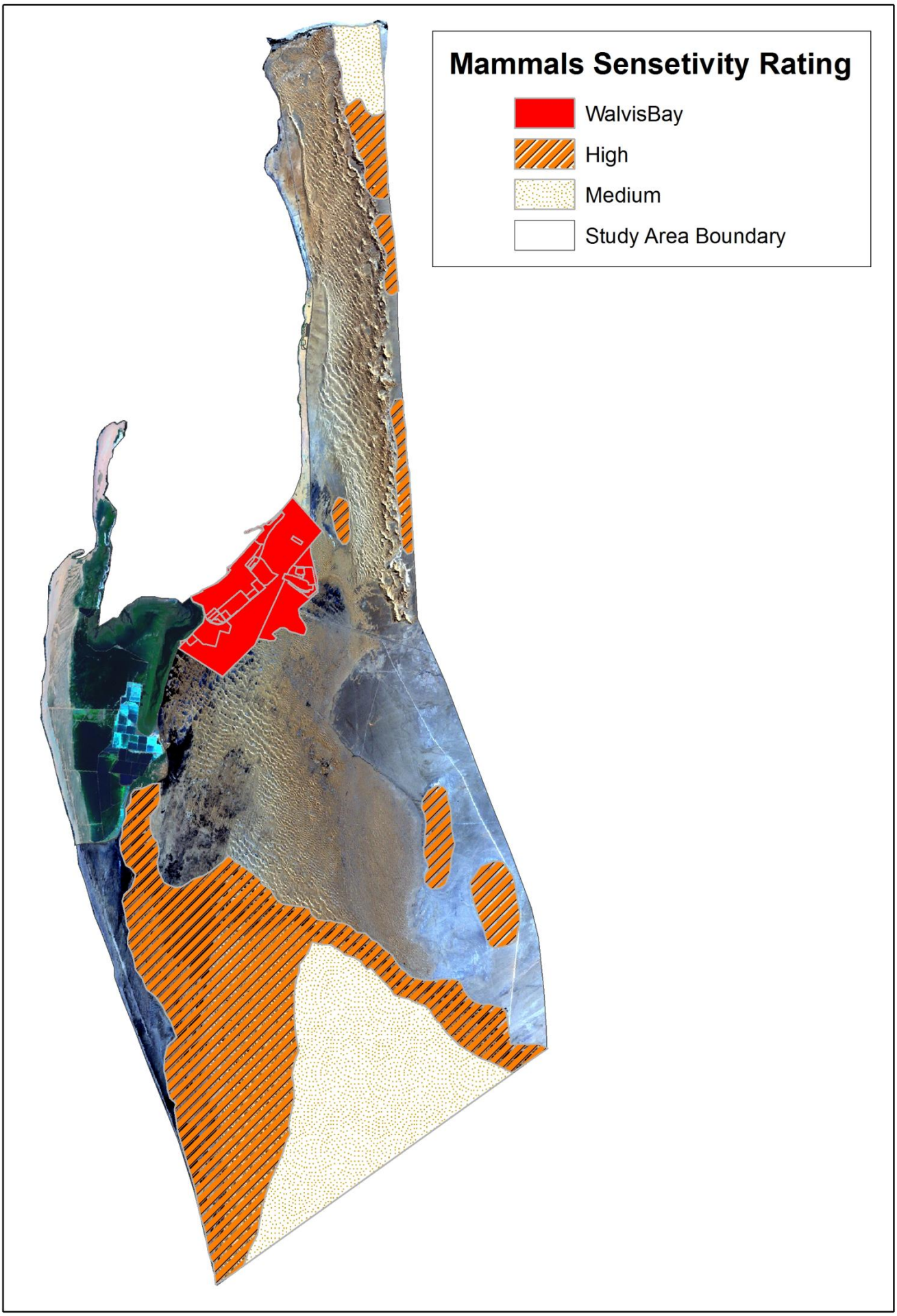


Figure 6.10: DST of important mammals sensitive area based on the results of the flora specialist work undertaken for this project.

6.2.3.1.4 Birds

The high proportion of endemic birds of which 50% (7 of 14 species) are endemic to Namibia and which are known and/or expected to occur in the general area is important and should be taken into consideration regarding development and various activities in the area (Fig. 6.11). Seabirds tend to be more mobile than most other birds with the highest species diversity and abundance along nutrient-rich waters such as the Benguela upwelling system along the Namibian coastline (Hockey *et al.* 2006). Species of greatest concern include all the endemics (e.g. Dune and Gray's Larks) as well as *Morus capensis* (Vulnerable – IUCN 2010), *Phalacrocorax capensis* (Near threatened – IUCN 2010), *Phalacrocorax neglectus* (Endangered – IUCN 2010), *Phalacrocorax coronatus* (Near threatened – IUCN 2010), *Phoenicopterus minor* (Endangered – IUCN 2010), *Haematopus moquini* (Near threatened – IUCN 2010), *Charadrius pallidus* (Near threatened – IUCN 2010) and *Sterna balaenarum* (Near threatened – IUCN 2010).

The Namibian coast is extremely important for the Chestnut-banded Plover (*Charadrius pallidus*) with Walvis Bay and Sandwich Harbour home to more than 80% of the species in Africa during certain parts of the year (Simmons *et al.* 2007). Cape Cormorant (*Phalacrocorax capensis*) and Crowned Cormorant (*Phalacrocorax coronatus*), which breed at the guano platforms along the Namibian coast, are other species of concern as fluctuating numbers are often a result of anthropomorphic influences (Crawford *et al.* 2007, Hamukwaya and Cunningham 2007).

However, the Damara Tern (*Sterna balaenarum*) which breeds in the gravel plain and sandy beach areas in the general area is the species possibly most threatened by development in the immediate area. With 98% of the Damara Tern breeding population being in Namibia (Braby 2010a; Braby 2011; Crawford and Simmons 1997); very low inter-colony dispersal rates with only 70 known colonies (Braby 2011), the importance of the general area cannot be stressed enough. Furthermore, some of the densest colonies – Caution Reef/Horse Graves – are located in this area (Braby 2010b). Disturbance and urbanisation, especially off-road vehicles, impact on breeding success and consequently pose the biggest threat to Damara Terns along the Namibian coast (Braby *et al.* 2001, Braby 2011, Braby and Braby 2002). Another species threatened by off-road driving, which also occur along the coast, are African Black Oystercatchers (*Haematopus moquini*) (Watson *et al.* 1996).

The Walvis Bay wetland is considered the most important coastal wetland in southern Africa and one of the top 3 in Africa (Bethune *et al.* 2007) and supports mainly Palaearctic migrants, often comprising up to 88% of the birds – e.g. up to 1% of the global Chestnut-banded Plover (approximately 2 000 individuals) are expected to occur in the Walvis Bay area (Whitelaw *et al.* 1978). Between 70 000 and 100 000 birds in winter and up to 250 000 in spring are supported by the wetland (Bethune *et al.* 2007). The Namib coast is especially important for 8 species and in terms of global populations it supports >90% of the world's Chestnut-banded Plovers (*Charadrius pallidus*); 31% of Cape Teals (*Anas capensis*); and 26% of African Black Oystercatchers (*Haematopus moquini*).

In terms of African endemic races it supports: >90% of the Black-necked Grebe (*Podiceps nigricollis gurneyi*); and 33% of the White-fronted Plover (*Charadrius m. Marginatus*); and in terms of southern African sub-continental populations it supports 31% of Pied Avocets (*Recurvirosta avocetta*), 13.7% of Greater Flamingos (*Phoenicopterus roseus*) and 10.3% of Lesser Flamingos (*Phoenicopterus minor*) (Williams and Simmons 2008a). Furthermore, up to 200 000 Holarctic shorebirds are supported seasonally along the Namibian coast belonging largely to 12 annually occurring species, of which 5 species occur in numbers that form a significant proportion of the southern African flyway populations – e.g. Curlew Sandpiper (*Calidris ferruginea* 35%); Sanderling (*C. alba* 32%); Ruddy Turnstone (*Arenaria*

interpres 17.5%); Grey Plover (*Pluvialis squatarola* 7.8%) and Red Knot (*Calidris canutus* 1.6%) (Williams and Simmons 2008b). According to Simmons and Brown (2009) 28 wetland bird species are of special concern in Namibia.

The Walvis Bay and Sandwich Harbour wetlands are furthermore classified as Ramsar sites (i.e. Namibia is signatory to the Ramsar Convention protecting important wetland sites) as well as globally Important Birding Area (IBA's) (Simmons 1998a). Another IBA in close proximity to Walvis Bay and the Sandwich Harbour area (Global IBA, Marine Reserve and Namib-Naukluft Park) are the Mile 4 Salt works (Swakopmund area – Global IBA, Private Nature Reserve) (Simmons 1998a). Coastal areas and wetlands are immensely important as 8 and 34 bird species are classified as Critically Endangered, Endangered or Vulnerable in each of the biomes (i.e. Coastal areas and Wetlands), respectively (Simmons 1998a).

The Palaearctic migrants visiting the Walvis Bay lagoon area – mainly during the summer – are also of great importance with disturbance to the feeding area impacting globally on these birds. The larger birds which follow local migration patterns such as the 2 Flamingo species (Walvis Bay – Etosha NP – Botswana) and the Great White Pelican (Walvis Bay – Etosha NP – Hardap Dam) would also be of concern. Flamingos have shown a downward trend in southern Africa with the Namibian coast regularly supporting 84% (40 000 to 47 000) of the Greater Flamingos and 85% (34, 000 to 40, 000) of the Lesser Flamingos, respectively (Simmons 1998c). This indicates the importance of the coastal areas for these species.

Development and recreation (e.g. "dune bashing" and quad bikes) are possibly the biggest threats to vertebrate fauna, especially reptiles and ground breeding birds, in the Kuiseb delta and dune belt area between Walvis Bay and Swakopmund. The known Damara Tern breeding sites – i.e. Caution Reef/Horse Graves – are viewed as the most important areas not to be disturbed.

Fig. 6.11 shows DST of important avian sensitive area based on the results of the flora specialist work undertaken for this project Species most likely to be adversely affected by coastal development would be the avian fauna specifically associated with these areas. As all development have potential negative environmental consequences, identifying the most important faunal species including high risk habitats beforehand, coupled with environmentally acceptable mitigating factors, lessens the overall impact of such development.

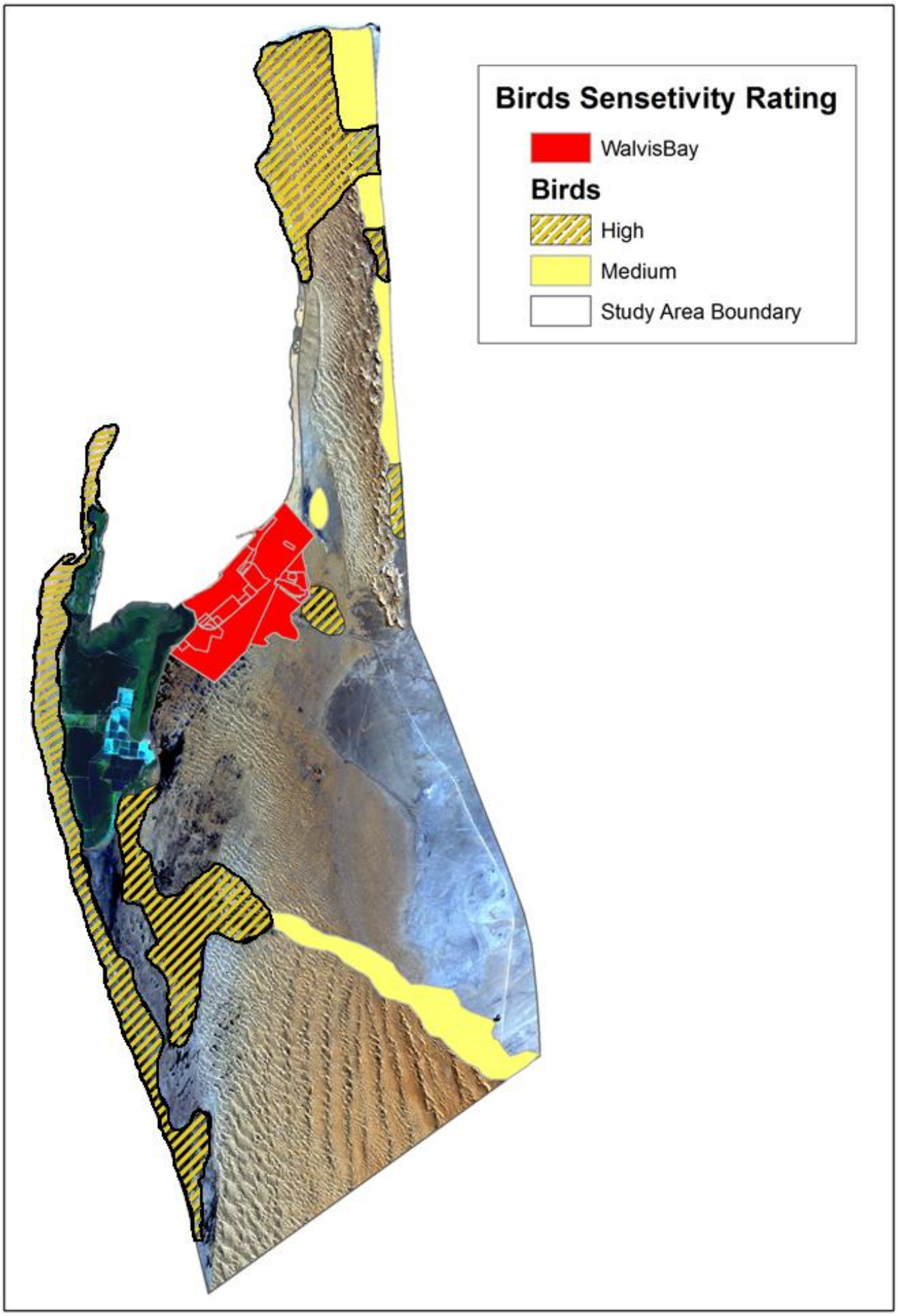


Figure 6.11: DST of important avian sensitive area based on the results of the flora specialist work undertaken for this project.

6.2.3.2 Flora Conclusions

6.2.3.2.1 Flora Overview

Between 26 and 39 species of larger trees and shrubs are known and/or expected to occur in the general area of which 6 species are classified as endemic (i.e. 15.4%) while up to 48 grasses – 6 to 37 species – occur in the general area. During the fieldwork, only 9 species of larger trees/shrubs (3 species protected by Forestry and 1 species being endemic – i.e. *Arthraerua leubnitziae*) and 8 species of grass (1 species being endemic – i.e. *Stipagrostis sabulicolia*) were confirmed from the general area.

Important flora species in the general area are the lichen fields and specific species – e.g. endemics (*Arthraerua leubnitziae* etc.) and economically important species such as *Acanthosicyos horridus*. *Acanthosicyos horridus* (!Nara) is endemic to the dunes of the Namib Desert and are important as a source of food to the Topnaar community living in the Kuiseb River area. It also serves as habitat to a variety of desert vertebrates and invertebrates (Seely 2010) and even serves as a nesting site for the Southern Pale-chanting Goshawk in areas devoid of larger trees/shrubs (N. Dreyer *Pers. com.*). Destruction and/or unscrupulous harvesting thereof would pose a threat to these plants and associated fauna.

The lichen fields are difficult to protect although some areas have been fenced off for better protection over the last few years. The overall diversity of lichens is poorly known from Namibia, especially the coastal areas and statistics on endemicity is even sparser (Craven 1998). More than 100 species are expected to occur in the Namib Desert with the majority being uniquely related to the coastal fog belt. Lichen diversity is related to air humidity and generally decreases inland form the Namibian coast (Schults and Rambold 2007). Off road driving is the biggest threat to these lichens which are often rare and unique to Namibia. Another importance of the lichens is that the endemic Damara Tern often uses these fields as a breeding ground (Craven and Marais 1986). To indicate how poorly known lichens are from Namibia, the recent publication by Schultz *et al.* (2009) indicating that 37 of the 39 lichen species collected during BIOTO surveys in the early/mid 2000's were new to science (i.e. new species), is a case in point.

Often deserts and plants associated with this marginal area look "dead" although are not, and thus not viewed as important. All desert vegetation serves as a source of habitat for desert dwelling fauna – e.g. arthropods and reptiles. All development have potential negative environmental consequences, but identifying the most important flora species including high risk habitats beforehand, coupled with environmentally acceptable mitigating factors, lessens the overall impact of such development.

6.2.4 Sensitive Areas

6.2.4.1 Overview Kuiseb Delta and Dune Belt Area

The overall area is well protected with the Kuiseb delta and dune belt area, with the exception of the Walvis Bay and Swakopmund town lands, formally protected within the recently proclaimed Dorob National Park. The Sandwich Harbour area furthermore falls within the Namib-Naukluft Park. According to the Uranium Rush Strategic Environmental Assessment (See MME 2010) conducted for the entire central coastal area, the following sensitive areas were identified in the general area:

(i) Biodiversity red flag areas:

- ✓ Coastal area immediately north of Walvis Bay (e.g. Important bird areas; high density of waders along beach; Damara Tern breeding areas);
- ✓ Walvis Bay Lagoon (e.g. Internationally recognised RAMSAR wetland and Important Birding Area);
- ✓ Kuiseb Delta (e.g. very high density of !Nara plants; important for Topnaar livelihoods);
- ✓ Sandwich Harbour (e.g. internationally recognised RAMSAR wetland and Important Birding Area).

(ii) Biodiversity yellow flag area:

- ✓ Inland Gravel Plains (e.g. Lichens, invertebrates and biodiversity associated with Tumas drainage area. Tumas 'mouth' – reedbed and ephemeral spring on eastern edge of dunes, hummocks and ephemeral wetland).

The entire area varies in sensitivity from the globally important Sandwich Harbour wetland in the south to the largely disturbed gravel plains north of the Kuiseb River and the largely sparsely vegetated sand dune system dominating the central areas to the lichen rich gravel plains in the north bordering the Swakop River. The actual dune belt area between Walvis Bay and Swakopmund is viewed as more resilient than many of the other habitats in the area. The leeward side of the dunes are viewed as more important as windblown detritus collects here luring a variety of detritus feeding wildlife. All vegetated patches within this dune belt system would be viewed as important habitat as this serves as habitat to a variety of vertebrate fauna. Fig. 6.12 summarises important flora sensitive area based on the results of the flora specialist work undertaken for this project. Areas of most concern – ranked in importance from **i- v** are expected to be:

(i) Sandwich Harbour;

(ii) Lichen Fields;

(iii) Riparian Vegetation of the Kuiseb River;

(iv) Riparian Vegetation of the Tumas River;

(v) Topographically higher areas comprising rocky outcrops, Caution Reef, Horse Graves and Salsola dune hummock fields in the Paaltjies area and associated areas.

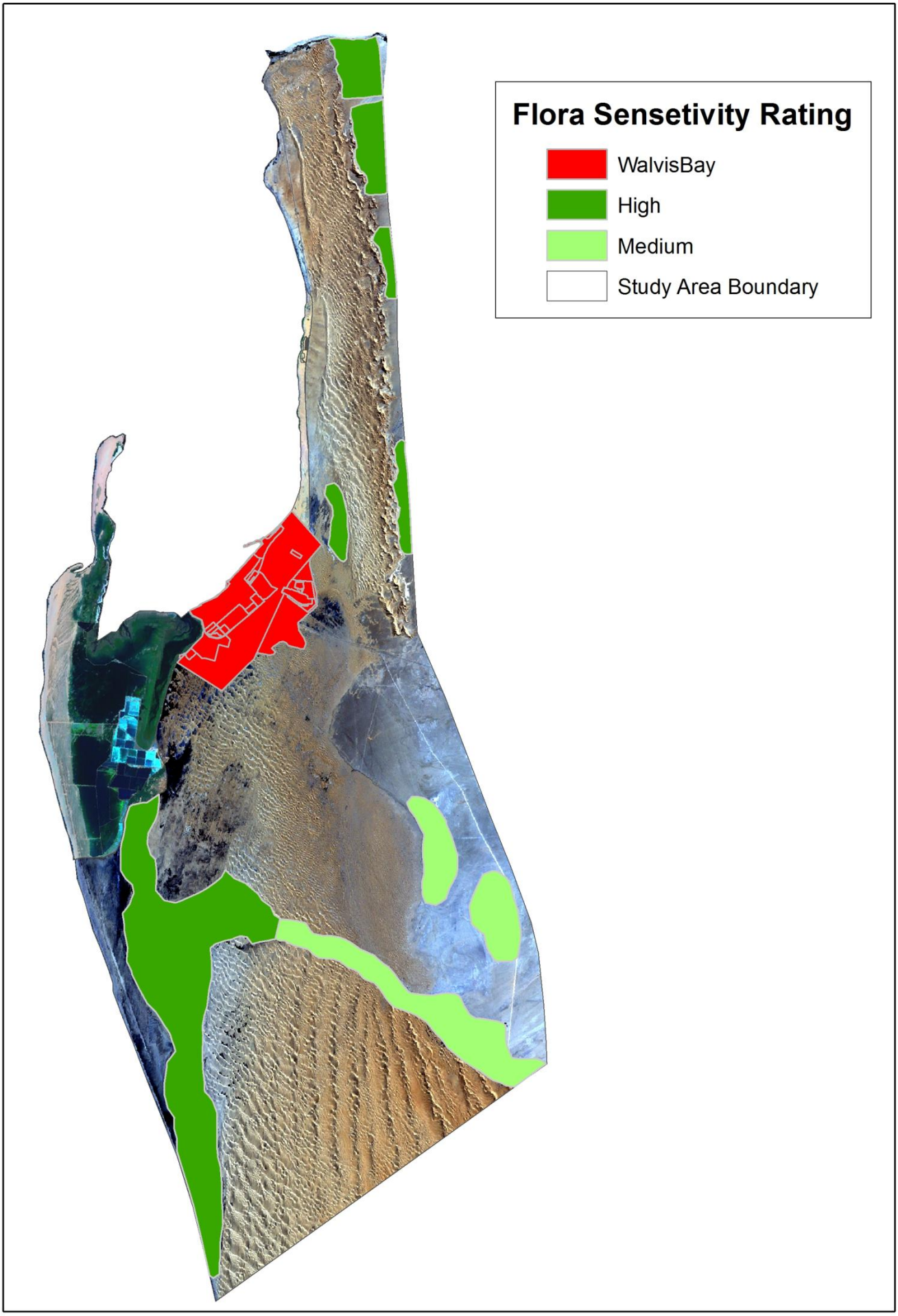


Figure 6.12: DST of important flora sensitive area based on the results of the flora specialist work undertaken for this project.

6.2.4.2 Sandwich Harbour

An analysis of Namibian biomes supporting red data species indicates that wetland habitats contain the greatest number of threatened species – i.e. 23% of all wetland birds (Brown *et al.* 1998). These coastal wetlands are immensely important as 8 and 34 bird species are classified as Critically Endangered, Endangered or Vulnerable in each of the biomes (i.e. Coastal areas and Wetlands), respectively (Simmons 1998a).

The Sandwich Harbour wetlands are classified as a Ramsar site as well as a globally Important Birding Area (IBA's) (Simmons 1998a). It is furthermore viewed as a site of special ecological importance in Namibia with its known distinctive values being its overall biotic richness, 36 fish spp., migrant shorebirds and red data birds (Curtis and Barnard 1998). According to Kolberg (n.d.) the area is a centre of concentration for migratory birds regularly supporting over 142,000 and 50,000 birds in summer and winter, respectively.

Fresh water in the form of seeps and easily accessible underground burrows excavated by Black-backed Jackal and Brown Hyena cannot be stressed enough in an otherwise extreme environment (Plate 6.26).

Plate 6.26: Fresh water as excavated by predators serves as a lifeline to a variety of other wildlife in the Sandwich Harbour dune belt area.

Development in this area should be avoided at all costs and access to the area should be strictly limited, controlled and monitored to ensure the overall environmental integrity of the area.

6.2.4.3 Lichen Fields

Lichens – with more than 100 species known from the Namib Desert – are a unique feature to the Namibian coastal environment and as their diversity and endemism is poorly known (Craven 1998); are easily disturbed especially by ORV's and often serve as a breeding

ground for the endemic Damara Tern (Craven and Marais 1986), they should be protected *in situ* wherever possible. The lichen fields in the northern gravel plains bordering the Swakop River are viewed as important and worthy of protection.

Development in this area should be avoided at all costs and access to the area should be strictly limited, controlled and monitored to ensure the overall environmental integrity of the area.

6.2.4.4 Riparian Vegetation

6.2.4.4.1 Kuiseb River

Although the Kuiseb River riparian vegetation belt is heavily invested by invasive alien plant species, the larger trees – *Acacia erioloba*, *Faidherbia albida* and *Tamarix usneoides* – are all protected species and serve as a source of food and habitat to a variety of wildlife (including the Topnaar domestic stock) in an otherwise extreme area. The riparian hummocks furthermore support *Acanthosicyos horridus*, which supports a variety of vertebrate fauna and furthermore is the main source of livelihood to the local Topnaar community. *Phragmites australis* forms extensive, albeit dense, habitat to a variety of especially birds in the Kuiseb River delta area.

Development in the Kuiseb River delta area should be avoided at all costs and access to the area should be strictly limited, controlled and monitored to ensure the overall environmental integrity of the area. Other development along the Kuiseb River should ensure the natural flow of the river and not impact on the indigenous vegetation.

6.2.4.4.2 Tumas River

Although typically sparsely vegetated, the Tumas River comprises of a number of drainage lines all abutting the eastern side of the dune belt. The *Arthraerua leubnitziae* dominated hummocks within this drainage system serves as habitat to a variety of vertebrate fauna.

Development in the Tumas River area should avoid disturbing the vegetated hummocks viewed as the most important habitat with access to the area limited, controlled and monitored to ensure the overall environmental integrity of the area.

6.2.4.5 Rocky Outcrops

Rocky outcrops typically serve as habitat to a variety of vertebrate fauna and flora species especially when occurring as virtual inselbergs in a harsh desert system. Rocky outcrops often have various lichen species not found on the surrounding plains and other important plants often associated with these outcrops include various Aloe species, *Gazania jurineifolia*, *Hereroa puttkamerana* and *Trichocaulon pedicellatum* (Seely 2010). Vertebrate species typically associated with such outcrops include the Namib Day Geckos.

Development on and utilisation of rocky outcrops should be avoided.

6.2.4.6 Other Areas

Other more specific areas also viewed as important are Caution Reef, Horse Graves and *Salsola* dune hummock fields in the Paaltjies area. The Caution Reef and Horse Graves areas are known existing or recently used breeding grounds for the endemic Damara Tern

and should be protected. The *Salsola* hummocks in the Paaltjies area serve as unique habitat for a variety of vertebrate (and invertebrate) fauna along the coast. The importance of these hummocks are often not understood or appreciated fully.

Development in the Caution Reef, Horse Graves and Paaltjies Salsola dune hummock areas should be avoided at all costs and access to the areas should be strictly limited, controlled and monitored to ensure the overall environmental integrity of the areas.

6.2.5 Recommendations

To conform to the principles of environmental management regarding future developments (including tourism), the following broad general recommendations are made:

(i) Avoid all development in the areas viewed as sensitive habitats – i.e. Sandwich Harbour, lichen fields, Kuiseb and Tumas Rivers, rocky outcrops, Caution Reef, Horses Graves and Paaltjies *Salsola* dune hummocks;

(ii) Maintain linkages between the various habitats and do not parcel up the area into virtual islands – i.e. maintain a system of "green spaces" which are linked and can serve as corridors for the movement of fauna;

(iii) Protect the larger tree specimens, especially protected species (i.e. *Acacia erioloba*, *Faidherbia albida* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952) as larger tree specimens as these often have cavities, dead branches, loose bark, etc. which serve as habitat to a variety of cavity and bark dwelling fauna – e.g. bats and birds – as well as unique and restricted range species (i.e. *Acanthosicyos horridus* and *Arthraerua leubnitziae*) – as these have economic and/or habitat related importance;

(iv) Avoid off road driving in sensitive areas especially viewed as susceptible to such activities – i.e. the gravel areas with lichens – as this results in the permanent and/or long term destruction of associated fauna (e.g. Damara Terns) and flora.

6.2.6 Envisaged Impacts

6.2.6.1 Introduction

All developments change are destructive to the local fauna and flora to some or other degree. Assessing potential impacts is occasionally obvious, but more often difficult to predict accurately. Such predictions may change depending on the scope of the development – i.e. the development, once initiated, may have a different effect on the fauna and flora as originally predicted. *Development here refers to recreation activities as well.* Thus continued monitoring of such impacts is imperative.

6.2.6.2 Faunal Loss / Disturbance

Habitat loss associated with various developments would be localised and dependant on the activities – i.e. some activities may have more impact than others. Table 6.12 summarises the potential/envisaged impacts expected to occur (faunal loss/disturbance is closely linked to habitat loss):

Table 6.12: Summary of potential/envisaged impacts expected to occur (faunal loss/disturbance is closely linked to habitat loss.

Description	Faunal loss/disturbance will vary depending on the scale/intensity of the development operation and associated and inevitable infrastructure. The impacts would be contained and/or limited depending on the various proposed developments envisaged. Each development would have to be assessed individually to ascertain the scale of impact.
Extent	Localised disruption/destruction of the habitat and thus consequently fauna associated directly with this habitat and the actual development sites. This however, would be relatively small areas with localised implications. Further developments – e.g. industry, road construction, etc. – throughout the area would however increase the extent of impact.
Duration	The duration of the impact is expected to be permanent over most of the proposed development sites once established. Most species (e.g. various birds and smaller mammals) are expected to re-colonise the area after completion of the development(s) – i.e. duration viewed as short to medium term – while other species are not expected to return (e.g. various secretive carnivores) – i.e. duration viewed as long term. This however, would be a relatively small area with localised implications.
Intensity	The actual development sites would be permanently altered with the intensity of faunal loss depending on the species involved – e.g. slow moving and sedentary species will succumb to development while the more mobile species are expected to vacate the area. Implications are expected to be localised, depending on the scale of developments. The areas adjacent the development sites should not be significantly affected. This, however, would depend on the proposed development, but should be limited to localised implications. Areas not directly affected by the development, although within the immediate vicinity, would be affected minimally. This would include dust, noise and other associated disturbances in the area, but be limited to the construction period(s). The effect that a variety of developments may have on the fauna is difficult to determine beforehand although increased disturbance associated with increased activities are expected. This would however be limited to the actual areas affected.
Mitigation	**1.** Avoid development and associated infrastructure in sensitive areas – e.g. Sandwich Harbour, Kuiseb and Tumas Rivers, lichen plains and rocky outcrops, etc. This would minimise the negative effect on the local environment especially unique features serving as habitat to various species. **2.** Implement and maintain track discipline limited to existing tracks and/or certain tracks with maximum speed limits (e.g. 30km/h) as this would result in fewer faunal road mortalities and associated dust pollution problems. **3.** Avoid off road driving in areas prone to scarring and especially the lichen fields. Nocturnal driving should also be avoided as this result in the destruction of slow moving fauna – e.g. various reptiles and other nocturnal species.

Table 6.12: *Cont.*

	4. Avoid and/or limit the use of lights during nocturnal activities as this influence and/or affects various nocturnal species – e.g. bats and owls, etc. and contribute to "light pollution". Use focused lighting for least effect. **5.** Prevent overnight activities in sensitive areas, especially the Sandwich Harbour area. **6.** Initiate a suitable and appropriate refuse removal policy at any future developments as littering could result in certain animals becoming accustomed to humans and associated activity and result in typical problem animal scenarios – e.g. Black-backed Jackal, etc. A "carry-in-carry-out" system should be mandatory in sensitive areas, especially the Sandwich Harbour area. **7.** Avoid the removal and damage of bigger trees (especially protected species – i.e. *Acacia erioloba*, *Faidherbia albida* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952) – during developments – including the development of access routes – as these serve as habitat for a myriad of fauna. This is relevant to developments in the Kuiseb River area. **8.** Maintain and link "green" corridors throughout the area to ensure the natural movement of fauna and prevent "island" scenarios which are detrimental to biodiversity. **9.** Rehabilitation of the disturbed areas – i.e. initial development access route "scars" and associated tracks, as well as temporary accommodation sites. Preferably workers should be transported in/out to the construction sites on a daily basis to avoid excess damage to the local environment (e.g. wood collection, poaching, etc.). Such rehabilitation would not only confirm the various development companies' environmental integrity, but also show true local commitment to the environment. **10.** Avoid development in the Kuiseb and Tumas Rivers or within 100m of these drainage line(s) to preserve the associated riparian fauna. **11.** Prevent (do not allow) domestic pets – e.g. cats – becoming established at the various development sites as pets can cause considerable damage to the local fauna. Cats also interbreed and transmit diseases to the indigenous African Wildcat found in the area. The indiscriminate and wanton killing of the local fauna by such pets should be avoided at all cost.
Frequency of occurrence	Expected to be "once off" and only affecting the selected site(s).
Probability	Definite (100%) negative impact on fauna is expected in the various development areas as well as the access route construction sites including the future (i.e. planned) developments. Highly Probable (75%) negative impact on fauna is expected in the general areas as a result of noise, increased activities, etc.

Table 6.12: *Cont.*

	Probable (50%) negative impact on fauna is expected from the infrastructure (roads/tracks). Precautionary principle (e.g. avoid unique habitat features as well as adhering to the proposed mitigating measures would minimise this) would decrease the significance of these potential impacts.
Significance	Before mitigation: **High** After mitigation: **Medium** to **Low**
Status of the impact	Negative Localised unique habitats (e.g. Sandwich Harbour, Kuiseb and Tumas Rivers riparian vegetation, lichen fields and rocky outcrops, etc.) with associated fauna would bear the brunt of this proposed development, but be limited in extent and only permanent at the actual development sites and access routes.
Legal requirements	Fauna related: Nature Conservation Ordinance No. 4 of 1975, CITES, IUCN and SARDB Habitat – Flora related: Forestry Ordinance No. 37 of 1952, Forest Act No. 72 of 1968, Nature Conservation Ordinance No. 4 of 1975, CITES
Degree of confidence in predictions	As an ecologist I am sure of the above-mentioned predictions made and would suggest that the mitigation measures be implemented to minimise potentially negative aspects regarding the local fauna in the area.

4.3 Floral loss/disturbance

Habitat loss associated with various developments (including tourism) would be localised and dependant on the activities – i.e. some activities may have more impact than others. Table 6.13 summarises the potential/envisaged impacts expected to occur.

Table 6.13: Summary of the potential / envisaged impacts expected to occur.

Description	Floral loss/disturbance will vary depending on the scale/intensity of the development operation and associated and inevitable infrastructure. The impacts would be contained and/or limited depending on the various proposed developments envisaged. Each development would have to be assessed individually to ascertain the scale of impact.
Extent	Localised disruption/destruction of the habitat and thus consequently flora associated directly with this habitat and the actual development sites. This however, would be relatively small areas with localised implications. Further developments – e.g. industry, road construction, etc. – throughout the area would however increase the extent of impact.
Duration	The duration of the impact is expected to be permanent over most of the proposed development sites once established. Most species, especially annuals, are expected to re-colonise the area after completion of the development(s) – i.e. duration viewed as short to medium term – while the destruction of mature trees are not expected to rebound soon – i.e. duration viewed as long term. This however, would be a relatively small area with localised implications.
Intensity	The actual development sites would be permanently altered with the intensity of floral loss depending on the species involved – e.g. slow growing species will be affected most. Implications are expected to be localised, depending on the scale of developments. The areas adjacent the development sites should not be significantly affected. This, however, would depend on the proposed development, but should be limited to localised implications. Areas not directly affected by the development, although within the immediate vicinity, would be affected minimally. The effect that a variety of developments may have on the flora is difficult to determine beforehand as this is dependent on the type of developments. This would however be limited to the actual areas affected.
Mitigation	**1.** Avoid development and associated infrastructure in sensitive areas – e.g. Sandwich Harbour, Kuiseb and Tumas Rivers, lichen plains and rocky outcrops, etc. This would minimise the negative effect on the local environment especially unique features serving as habitat to various species. **2.** Identify protected and unique species (e.g. *Acacia erioloba*, etc. [Forestry Ordinance No. 37 of 1952 species] before the commencement of development activities in areas where these occur and avoid. **3.** Prevent and discourage the collecting of firewood as dead wood has an important ecological role. Such collecting of firewood, especially for economic reasons, often leads to abuses – e.g. chopping down of live and/or protected tree species such as *Acacia erioloba* which is a good quality wood. This would only be relevant to the Kuiseb River riparian vegetation.

Table 6.13: *Cont.*

	4. Avoid the removal and damage of bigger trees (especially protected species – i.e. *Acacia erioloba*, *Faidherbia albida* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952) – during developments – including the development of access routes – as these serve as habitat for a myriad of fauna. This is relevant to developments in the Kuiseb River area. **5.** Avoid the removal of interesting and unique flora (especially restricted range species – e.g. *Acanthosicyos horridus* and *Arthraerua leubnitziae*). **6.** Avoid development in the Kuiseb and Tumas Rivers or within 100m of these drainage line(s) to preserve the associated riparian fauna. **7.** Prevent the planting of potentially alien invasive plant species (e.g. *Pennisetum setaceum*, etc.) for ornamental purposes as part of the landscaping at the various developments. Alien species often "escape" and become invasive causing further ecological damage. **8.** Implement a policy of "no tolerance" towards the existing invasive alien plant species (i.e. *Argemone ochroleuca*, *Datura* spp., *Eucalyptus* sp., *Nicotiana glauca*, *Prosopis* sp. and *Ricinus communis*) in the area. This should include the removal and destruction of these species throughout the proposed development areas. Such activity would be beneficial to the overall ecology of the area, especially the Kuiseb River area where most of these aliens currently occur. **9.** Rehabilitation of the disturbed areas – i.e. initial development access route "scars" and associated tracks, as well as temporary accommodation sites. Preferably workers should be transported in/out to the construction sites on a daily basis to avoid excess damage to the local environment (e.g. wood collection, poaching, etc.). Such rehabilitation would not only confirm the various development companies' environmental integrity, but also show true local commitment to the environment.
Frequency of occurrence	Expected to be a "once off" issue affecting the selected site(s).
Probability	Definite (100%) negative impact on flora is expected in the actual development areas as well as the access route construction sites. This however, would be much localised and cover limited areas. Highly Probable (75%) negative impact on flora is expected from the infrastructure (roads/tracks). Precautionary principle (e.g. avoid unique habitat features as well as adhering to the proposed mitigating measures would minimise this) would decrease the significance of these potential impacts.
Significance	Before mitigation: **High** After mitigation: **Medium** to **Low**
Status of the impact	Negative: Localised unique habitats (e.g. Sandwich Harbour, Kuiseb and Tumas Rivers riparian vegetation, lichen fields and rocky outcrops, etc.) with associated flora would bear the brunt of this proposed development, but be limited in extent and only permanent at the actual development sites and access routes.
Legal requirements	Flora related: Forestry Ordinance No. 37 of 1952, Forest Act No. 72 of 1968, Nature Conservation Ordinance No. 4 of 1975, CITES
Degree of confidence in predictions	As an ecologist I am sure of the above mentioned predictions made and would suggest that the mitigation measures be implemented to minimise potentially negative aspects regarding the local flora in the area.

6.3 Socioeconomic Environment of the Erongo Region

6.3.1 Overview

The proposed Kuiseb Delta and Dune Belt projects localities are situated in Walvis Bay linked to a web of coastal transportation, communication and utility systems and networks. Walvis Bay falls within the Erongo Region which is one of the 13 regions in Namibia and is located in the western part of the country. Because of its geographical location and the fact that the region contains the harbour towns of Swakopmund and Walvis Bay, it serves as a hub in terms of the movement of people and goods. There has also been something of a mining boom in Erongo in recent times. There are a number of established mines such as Rössing and Langer Heinrich, while a growing number of mines are starting up in the region, and many more are in the exploratory stages. Uranium is the main commodity being mined in the region. Tourism and fishing are the other major contributors to Erongo's economy.

Erongo comprises the Walvis Bay and Swakopmund Magisterial districts up to the Ugab River and also includes the Omaruru and Karibib magisterial districts. To the west, Erongo is bordered by the Atlantic Ocean while on land it borders with the following regions: Kunene – North, Otjozondjupa – east, Khomas – Southeast and Hardap – south. The region has a total land area of 63,579 km^2 which is approximately 7.7% of the country's total land surface (NPC, Census Indicators, 2001). The National Population and Housing Census of 2001 estimated the population of the region to be 107,663 (up from 55,470 in 1991) with a 53.5%:46.5% male to female ratio.

Although Swakopmund serves as the administrative centre of Erongo, Walvis Bay is of much greater economic and strategic importance as it is a much deeper harbour that can support international cargo ships and tankers. It is thus Namibia's principal port town which provides opportunities in fishing, shipping and transport and various other support industries such that it supports a population of about 60,000 people. It is also an important trade link to other SADC countries through the Trans-Kalahari and Trans-Caprivi and Trans-Cunene highways. The town is also home to many people who work on the adjacent mines. In addition the Walvis Bay lagoon is a designated Ramsar wetland site of international importance which attracts many tourists to the town. Because of these factors, the town is growing rapidly and is attracting migrants seeking employment from allover Namibia and other countries. The area was fully incorporated into the Erongo Region in 1994.

The following is the summary of the socioeconomic and infrastructural settings of the Walvis Bay and the Erongo Region:

- **Governance:** The regional capital of the Erongo Region is Walvis Bay and the region has a total area of 63 586 km^2;

- **Population:** Based on 2001 census the region has a total population of 107 663 with 85% of the population living in urban areas;

- **Industries:** Major industries are fisheries, tourism, services, mining and agriculture;

- **Air:** International air connections for both passengers and freight are available at Windhoek's Hosea Kutako International Airport to Walvis Bay. Walvis Bay International Airport is located about 10 km from Walvis Bay and the airport has regular flights to Cape Town, Johannesburg and Windhoek. Direct destinations include the strategic regional hub of Johannesburg, and the European city of Frankfurt. Air Namibia is the national carrier and other international airlines operating in the country are South African Airways, British Airways/Comair, TAAG and LTU. There are also

direct flights between Windhoek and Luanda, Lusaka, Harare, Livingstone and Cape Town, as well as domestic flights to local destinations from the Windhoek's Eros Airport.

- **Sea:** Walvis Bay, with its world-class standard of cargo handling and sheltered deepwater harbour, is poised to become the most important port on Africa's west coast and a regional container hub for southern Africa (Plate 7.12). The completion in 2000, of the deepening process and the building of a new enlarged container terminal able to handle vessels with a capacity of some 2000 to 2400 TEUs (Twenty-foot equivalent unit, a measure used for capacity in container transportation) put the port on a par with Cape Town and Durban. Container vessels from Europe can save three days' journey time by loading and/unloading in Walvis Bay, rather than Cape Town, while cargoes for central and Southern Africa from elsewhere in the Atlantic region can gain up to seven days by using Walvis Bay and going further overland.

  The dedicated facilities for a range of commodities, including containerised cargo, refrigerated produce, break bulk, dry bulks, and petroleum products. The port currently handles around 2.5 million tons of cargo annually, with an average turnaround time of about 12-18 hours for container vessels. Products include foodstuffs, marble blocks, lead and copper ingots and an annual 500,000 tons of salt. As well as excellent logistical support services, there is a thriving ship repair and marine engineering industry at Walvis Bay. Walvis Bay Port is administered by the Namibian Ports Authority (NamPort), a state owned organization established in 1994, part of whose role is to ensure the smooth operation of cross-border trade. The ports enjoy good industrial relations, with well-motivated workforces, and are able to offer a high standard of stevedoring to complement their modern dockside equipment;

- **Road:** Walvis Bay is well linked to the developed road network covering more than 40,000 kilometres and providing access to the majority of towns in Namibia. The primary route the B2 connecting Walvis Bay and Swakopmund is tarred and links to the Trans-Caprivi Highway which provides an all-weather road link between Walvis Bay and Botswana, Zambia and Zimbabwe, as well as the Democratic Republic of Congo. The Trans-Kalahari Highway links Walvis Bay with South Africa's Gauteng industrial heartland via Botswana. Previously this region used Durban as its natural gateway. The highway is also connected to the Maputo Corridor on Africa's east coast, thus providing a transport link across the entire breadth of the continent;

- **Rail:** A national network of railways covering 2, 382 kilometres connects Walvis Bay and Lüderitz with key destinations in Namibia and South Africa. Much of the containerized traffic at Walvis Bay goes by rail, and the port has its own marshalling yard for maximum operational efficiency. Thousands of tons of bulk minerals from mines in South Africa and Namibia are transported directly to the quayside by rail for export;

- **Walvis Bay Corridor:** The Walvis Bay Corridor is the name for a newly constructed network of transport which has opened up access to landlocked southern Africa for destinations west of the continent by the shortest possible route. Completed in 1998, and using the port of Walvis Bay as the trade gateway, its main arteries are the Trans-Caprivi and Trans-Kalahari Highways. The Walvis Bay to Grootfrontein railway line also forms part of the corridor;

- **Telecommunications:** Walvis Bay is one of the few towns in Namibia that enjoys world class telecommunications system, with telephone and internet connections widely available, thanks to recent substantial investment in the telecommunications

infrastructure including the installation of optical fibre cable networks and broadband systems. An international satellite links Namibia to worldwide telecommunications services. A GSM900 network is operated by Mobile Telecommunications LTD (MTC), Namibia first cellular service provider. About 80 per cent of the population is within reach of this network. MTC currently has roaming agreements with 160 countries worldwide, and visitors from these countries can use their GSM900 phones in Namibia without difficulty;

- **Business Services:** The full range of business support services is available in Walvis Bay, including banking and finance, insurance, stock broking, accountancy, general business consultancy, advertising and marketing agencies and conference facilities. The Country has a well-established banking system. The Bank of Namibia is responsible for issuing currency and is the foreign exchange authority, lender of last resort to banking institutions, banker to the Government and the commercial banks and the supervisory authority on financial institutions and monetary matters. Commercial banks operate through a nationwide network of branches and offer a comprehensive range of banking services, including current account and overdraft facilities, term deposits, discounting of bills, foreign exchange and a variety of loan products.

  The major banks also represented in Walvis Bay are Bank Windhoek Ltd., the Nedbank Bank of Namibia Ltd., First National Bank of Namibia and Standard Bank of Namibia Ltd. Most also provide specialised merchant banking facilities. International services are available through inter-bank arrangements. Electronic banking and teller services are available in Walvis Bay and all major centres in Namibia. The Namibian Dollar (N$) is divided into 100 cents. It is linked to and on a par with the South African Rand (R) which is also legal tender in Namibia. The Namibian Stock Exchange is Africa's second largest in terms of total market capitalization and among the continent's most technically advanced bourses;

- **Energy:** There is a 66 kV power line linking Walvis Bay and Swakopmund. NamPower which has restructured and repositioned itself to address the challenges of a restructured Namibian electricity supply industry is actively pursuing all avenues for increasing electricity generation capacity in the country. The main sources of power are the thermal, coal-fired Van Eck power station outside Windhoek (120 megawatts), the hydroelectric plant at Ruacana Falls (240 megawatts), the diesel driven Paratus power station at Walvis Bay (24 megawatts) and one interconnecting line from Eskom (South Africa) (200 megawatts). To meet the growing power demand, NamPower commissioned the construction of the 900-km, 400kV interconnector power line from Kenhardt in South Africa to Auas near Windhoek in 2000. In terms of the availability of fuels to run the project in the area, the country has a well-established downstream oil marketing infrastructure that is closely linked with South Africa. There are five main companies distributing and marketing fuel products in Namibia.

6.3.2 Economic Setting

6.3.2.1 Mining

Due to the scale of its influences across social, economic and environmental spheres, mining is a key activity within Namibia and the Erongo region. There has been a noticeable decline in recent times in the contribution of the traditional powerhouses of mining in Namibia, such as gold and diamonds. But other minerals, particularly uranium, are benefitting from an increased worldwide demand for clean nuclear energy. This has major repercussions for the Erongo region as it is known to hold vast quantities of uranium.

The Chamber of Mines of Namibia places Namibia as the world's fifth largest producer of uranium, which comes exclusively from the Erongo region. Erongo's history of uranium mining goes back to 1976 with the establishment of Rio Tinto's Rössing uranium mine. This is still the largest employer in the region with 1,175 employees recorded in 2007 (Rössing Uranium 2007). Rössing has responded to the uranium boom by announcing a production expansion programme.

Paladin Energy's Langer Heinrich Uranium project came on stream in 2007 and between them these two mines produce about 10% of the world's uranium. The French nuclear utility company Areva has recently opened a uranium mine at Trekkopje and this is set to be followed by another at Valencia. Other mines owned by Bannerman, Swakop Uranium and Reptile Uranium may also come on stream in 2012. The existing production expansion as well as oncoming mines is likely to impact greatly on the region, not only economically and socially but also environmentally. Mines are notoriously large consumers of energy and water, both of which are in short supply in the Erongo region.

There is also a gold mine near to Karibib known as Navachab Gold mine, while salt is mined north of Swakopmund and south of Walvis Bay. Marble, granite, semi-precious stones, industrial rocks and sand are also mined in the region.

6.3.2.2 Fisheries

With Namibia having one of the richest fishing grounds in the world owing to the cold Benguela current which flows along the coast, the Namibian government sees commercial fishing as one of the main pillars of its economy (NPC 2001, Census Indicators, 2001). Indeed the fisheries sector has been one of the major success stories of the post-independent government. There has been a steady growth of both stock levels and catches since 1990, and it is estimated that 600,000 metric tonnes of fish and shellfish are landed per annum. The bulk of this is processed at Walvis Bay and exported, which provides much employment to the town. Exports increased by 21% between 2006 and 2007 alone (Namibia Trade Directory 2010) such that the fishing industry is now Namibia's second biggest export earner. Hake and horse mackerel are among the key species exported.

6.3.2.3 Infrastructure

Given the importance of mining and the high volume of trade passing through Walvis Bay, Erongo is served by an impressive infrastructure network. It is well connected both by tarred road and rail to Windhoek and the north of Namibia. A well-developed road network also links Walvis Bay to the wider SADC market. The Trans-Kalahari Highway connects to Botswana and South Africa's industrial heartland in Gauteng Province, while the Trans-Caprivi Corridor links the port to important industrial areas in Zambia, Southern DRC and Zimbabwe. The Trans-Cunene Corridor serves the Southern Angolan region via Tsumeb and Oshikango.

Swakopmund and Walvis Bay are linked by a 220 kV power line from the national grid. Reforms in the energy sector, in line with the Energy White Paper Policy (1998), are being felt in Erongo. For example the regional distribution of electricity has been handed over to the Erongo Regional Distributor (RED) Company (Pty) Ltd. Erongo RED came into being in 2005 and the company serves 53,417 customers in the region (Namibia Trade Directory 2010). It lists as a priority the need to increase capacity for bulk supply for local and regional development as well as increasing mining and industrial development in the area. The need for a diverse mix of energy sources for Namibia is further outlined in the Energy White Paper Policy (1998).

6.3.2.4 Conservation and Tourism

There are a wide variety of tourist attractions in the Erongo region and this industry has much potential to drive development in the region. Swakopmund and Walvis Bay are key attractions for Namibians and international visitors alike, from where activities as diverse as dolphin viewing, bird watching, quad biking and dune-boarding can be practiced. Swakopmund is fast becoming the adventure sports capital of Southern Africa. The Cape Cross seal reserve, 120 km north of Swakopmund, represents the largest land-based seal breeding colony in the world. In the interior, natural attractions include the Spitzkoppe, Brandberg and Namib-Naukluft Park as well as interesting indigenous peoples such as the Topnaar. The Erongo region is experiencing a rapid growth in communal conservancies which is a clear sign that communities are seeking to benefit from the tourism opportunities in the region.

6.3.2.5 Agriculture

Although agriculture has been the backbone of Namibian society for the past century, it typically only contributes a small amount to overall GDP. Interestingly in Erongo, agriculture contributes particularly little towards both livelihoods and GDP. The potential of agriculture is limited by the extreme aridity of the region, particularly in the western part. In the west, ephemeral rivers are virtually the only areas where pastoralism and small-scale farming can be practised. Subsistence farming (typically goat herding) does occur further inland, particularly in the North-East while the Topnaar people combine pastoralism with the collection of wild plants such as the !nara melon in the Kuiseb river valley. The inhospitability of the land perhaps explains why 80% of the population resides in urban areas. This is an unusually high percentage when compared to other Namibian regions, with the exception of Khomas.

6.3.3 Social Setting

6.3.3.1 Population and Migration

The social environment of Walvis Bay and the wider Erongo region has largely been shaped by the economic factors outlined above. The importance of mining in the region, as well as its relatively high level of industrialisation, and the recent increases in tourism, has attracted a large number of migrant labourers to the region. The fact that only 40% of Erongo's population was born in Erongo is testament to this (NPC 2007, Census data of 2001). Similarly Erongo differs from most other regions in Namibia in that its population is highly urbanised (80% of the people live in urban areas with the remaining 20% in rural areas). Erongo also typically fares better than other regions in terms of variables such as income, employment, health and education. However considerable social problems and challenges such as shelter and HIV AIDS exist in the region.

6.3.3.2 Population and Migration

Migration is a key social factor at work in Erongo, which continues to attract a large number of people in search of employment. The population growth rate from 1991-2001 was 94% (NPC 2007, Census Indicators, 2001). Walvis Bay Urban constituency is the most populous with 26% of the total population (NPC 2007, Census Indicators, 2001). Interestingly 20% of Erongo's population was born in Ohangwena, Omusati and Oshana regions, with men accounting for 65% of this figure (NPC 2007, Census Indicators, 2001) showing the migration of mainly male workers from the northern regions to the coast. This is further

reflected in the fact that Oshiwambo is the most commonly spoken language at home in the region.

6.3.3.3 HIV/AIDS

HIV/AIDS is having a strong negative social and economic impact in Namibia. The prevalence rate of HIV/AIDS was estimated at 19.9% in 2006 (NDP3). While child health, nutrition and other health areas are slowly improving, the increasing prevalence of AIDS among the population is having a detrimental impact on health with life expectancy falling, particularly in the poorer regions of Namibia (ERM, 2005). HIV/AIDS is also often associated with areas affected by high levels of migration.

While exact figures are difficult to come by, the Erongo Regional Poverty Profile of 2005/2006 states that HIV/AIDS and orphanhood are steadily increasing throughout the region. However it is generally considered a more serious problem in urban areas. Overall, the socio-economic impact of HIV/AIDS is significant, and includes reduced workforce productivity, premature loss of main bread-winners, cost of medicine and funerals, need for workforce replacement and training, and orphan care.

6.3.3.4 Access to Services, Livelihoods and Income

The high urbanisation rate in Erongo means that access to education, health services and other facilities is better than most other regions in Namibia. According to the Population and Housing census (2001), 96% of households had access to safe water and 73% had access to electricity. The literacy rate stood at 92%, while Erongo had an unemployment rate of 34%. These figures compare very favourably with other regions. However, it is known that there is high level of inequality in Namibia with haves having more and the have-not being the poorest. For example, over 90% of households in urban areas use flush toilets compared to 25% in rural areas. Only 4% of households derive their main sources of income from farming, while 67% came from wages and salaries and 10% from pensions (NPC, Census Indicators 2001).

6.3.3.5 Marginalised Communities

The Topnaar people are the most marginalised group in Erongo. Since their ancestral land was declared a national park, they have essentially been squatters on their own land mainly along the Kuiseb River. They are no longer allowed to hunt and they subsist from small-scale goat herding along the ephemeral Kuiseb River. Their nutritional and medicinal needs are mainly met by the !Nara melon, which is the main plant able to withstand the harsh conditions of the region. Other marginalised communities include retrenched mine workers who become stranded in the region without any other employment opportunities.

6.3.4 Potential Socioeconomic Impacts

6.3.4.1 Likely Positive Social Impacts

a) Employment

There will be many positive social impacts resulting from the proposed projects which will benefit Topnaar community particularly with respect to the proposed Kuiseb Delta Project. Overall, however, the value chain of provision of employment to skilled, semi-skilled and

unskilled labourers is one of these positive benefits as these employees will be required at different stages of the proposed projects development. It is likely that local people with relevant qualifications will be employed or contracted to do various tasks as required and more other opportunities are likely to arise for both semi-skilled and unskilled workers. This will help ease the chronic unemployment situation in the country, which was recently estimated at 52%. In this way the projects will also contribute towards the government's Vision 2030 plan. Although the exact total number of temporary and permanent local jobs as well as contracting opportunities to be created is not yet clear, the proposed projects will definitely create opportunities throughout the project life cycle.

b) Research, Skills Development and Transfer of Knowledge

The proposed projects will contribute significantly towards skill development and transfer. Key areas to benefit will be knowledge and research opportunities in tourism and conservation. The facilities of the proposed projects could be used by students to do research and enhance their knowledge of the practicalities of tourism and conservation opportunities thus contributing to knowledge creation.

The initiation of training and capacity building programmes would impart technical skills and ensure skills transfer to marginalised communities. The transfer of skill must be implemented during pre-contraction in order to insure that by the time the projects are operational, local people and in particular the marginalised people will be already fully skilled to participate in the operation of the both proposed projects.

6.3.4.2 Likely Positive Economic Impacts

a) Infrastructural Development

The proposed projects will both likely to contribute positively to the infrastructural development in the local area. There is the possibility that projects support infrastructures and other amenities could be built at the projects sites. It is planned that the existing access road(s) will be upgraded or constructed during the preconstruction phase, so that the proposed activities could be implemented effectively. The proposed projects and in particular the Kuiseb Delta Project will contribute to the socioeconomic development of the local residents (Topnaar community) by providing an opportunity for socioeconomic improvements on their livelihoods and economic status.

6.3.4.3 Likely Negative Social Impact

There are also some negative social impacts which may arise as a result of the proposed projects. It is anticipated that the current and future land uses, zonation and existing infrastructures and services may be altered around the Kuiseb Delta and Dune Belt Areas. However, incentives could be provided to ensure that these impacts are mitigated and solutions are proposed in the EMP on how these could be solved.

a) HIV/AIDS

HIV/AIDS is one factor that may pose a big threat to local communities. With the movement of employees and visitors as well as job seekers in and out of the projects sites, there is a possibility that HIV/AIDS infections might occur. Therefore, as part of the Corporate Social Responsibility, the developer / operator for each of the proposed projects may need to implement HIV/AIDS wellness programmes and awareness campaigns among local community, employees and visitors. It is also imperative that employees go through regular

checkups for various other medical conditions associated with areas as dry as the Erongo Region.

6.3.4.4 Likely Negative Economic Impact

There are no likely negative economic impacts associated with the proposed two projects (Kuiseb Delta and Dune Belt Projects) and therefore the positive impacts much outweigh the possibility of any negative impacts.

6.3.4 Socioeconomic Recommendations

6.3.4.1 Community Engagement

The following is the summary of the community engagement provisions within the framework of the national legislation and must be adhered to throughout the proposed projects life cycles:

- Ongoing process involving the disclosure of information and possibly consultations where the local communities may be affected by project-related risks and adverse impacts;

- Consultation should commence early in the Environmental Assessment and implementation process and involve the prior disclosure of relevant and adequate information (including draft documents and plans); focus on the social and environmental risks and adverse impacts, and the proposed measures and actions to address these; and take place on an ongoing basis as risks and impacts arise. The process must be inclusive, culturally appropriate and designed to cater for the language preferences of the affected local communities, their decision-making process, and the needs of disadvantaged/vulnerable groups within the marginalised community;

- Engagement must be free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information;

- The process should be documented, especially the measures taken to avoid or minimise certain risks to and adverse impacts on the affected community members;

- A grievance mechanism should be established if there is a chance of ongoing risks to or adverse impacts on affected communities and the latter should be informed of the mechanism early in the engagement process; concerns should be addressed promptly, through an understandable and transparent process that is culturally appropriate and readily accessible to all members of the affected community.

6.4 !Khuiseb Delta Archaeological Baseline

6.4.1 Research History

On the coast of Namibia, dense local concentrations of archaeological sites are associated with some of the larger river mouths. Open coastline environments are generally poor in archaeological sites, as are the mouths of smaller rivers. The river courses, although mainly dry, had in the past sufficient water beneath the surface to sustain small human groups.

River environments also have edible plants and wild game, and these, combined with littoral and marine foods, offer a more stable subsistence base than any area in the immediate hinterland. Nowhere on the Namib coast is the combination of such resources more favourable than in the vicinity of the !Khuiseb Delta, and it is therefore no surprise that this area has the largest concentration of archaeological sites on a coastline over 2, 000 km in length. The relative density of archaeological sites in the !Khuiseb Delta compared to Namibia as a whole is shown in Fig. 6.13.

Detailed archaeological surveys of the !Khuiseb Delta have established the characteristics of past settlement in this area, yielding a range of radiocarbon and relative dates associated with a wide diversity of cultural material, evidence of food preferences, and human remains. These research results are reviewed in some detail below[1]. However, it is necessary to understand that it was not the object of these surveys to locate and record every archaeological site in the area. Instead, the surveys focussed on carefully chosen blocks of land with particular characteristics of physical setting, so as to produce a representative sample of the local archaeology. Altogether 235 archaeological sites were documented in the !Khuiseb Delta during the course of several field surveys covering ten sample blocks, and a total of 83km^2 (Kinahan 2000: 31). Of these sites 86 were shell accumulations, 69 were complex assemblages of cultural material, and the remaining 94 were small shell scatters and single artefact finds. The dating of the sites covers the last 2, 000 years; 155 of the site pre-dating European contact, and the great majority of post-contact sites were concentrated in the Walvis Bay dunefields.

The result of these surveys was to show that archaeologically, the !Khuiseb Delta consists of a central, or core area in the Walvis Bay dunefields, where the greatest concentration of well-preserved sites has been recorded. To the north of Walvis Bay, there is a minor group of sites associated with the mouth of the extinct Tumas River. To the south, there are two important archaeological localities, Frederiksdam and Sandwich Harbour. The lower !Khuiseb River between Gobabeb and Rooibank is associated with a narrow strip of thinly scattered sites close to the course of the river itself. The overall picture is therefore of a distribution that is confined to the lower !Khuiseb until it flares out among the Walvis Bay dunefields, particularly in the area nearest to the lagoon. The groups of archaeological sites north and south of this core zone are peripheral. An important exception is the area around Sandwich Harbour, which does not form part of this study, although it is critical to the archaeology of settlement in this area and the recent history of the ǂAonin.

Earlier archaeological research in the Walvis Bay area concentrated exclusively on the shell middens near Wortel (e.g. Avery 1984) and used the available ethno-historical and ethnographic descriptions of the ǂAonin as their explanatory base. The more recent research (Kinahan 1991; Kinahan 2000) uses a far larger sample base covering the entire delta environment and is consequently able to test some assertions in the ethno-historical record. The result is a more nuanced account of the !Khuiseb archaeology in which, for the first time anywhere in the southern African region, the archaeological evidence was used to counter the traditionally one-sided understanding of first contact based on European documentary sources.

[1] See 5. Resources, BIBLIOGRAPHY for specific references to published and unpublished reports

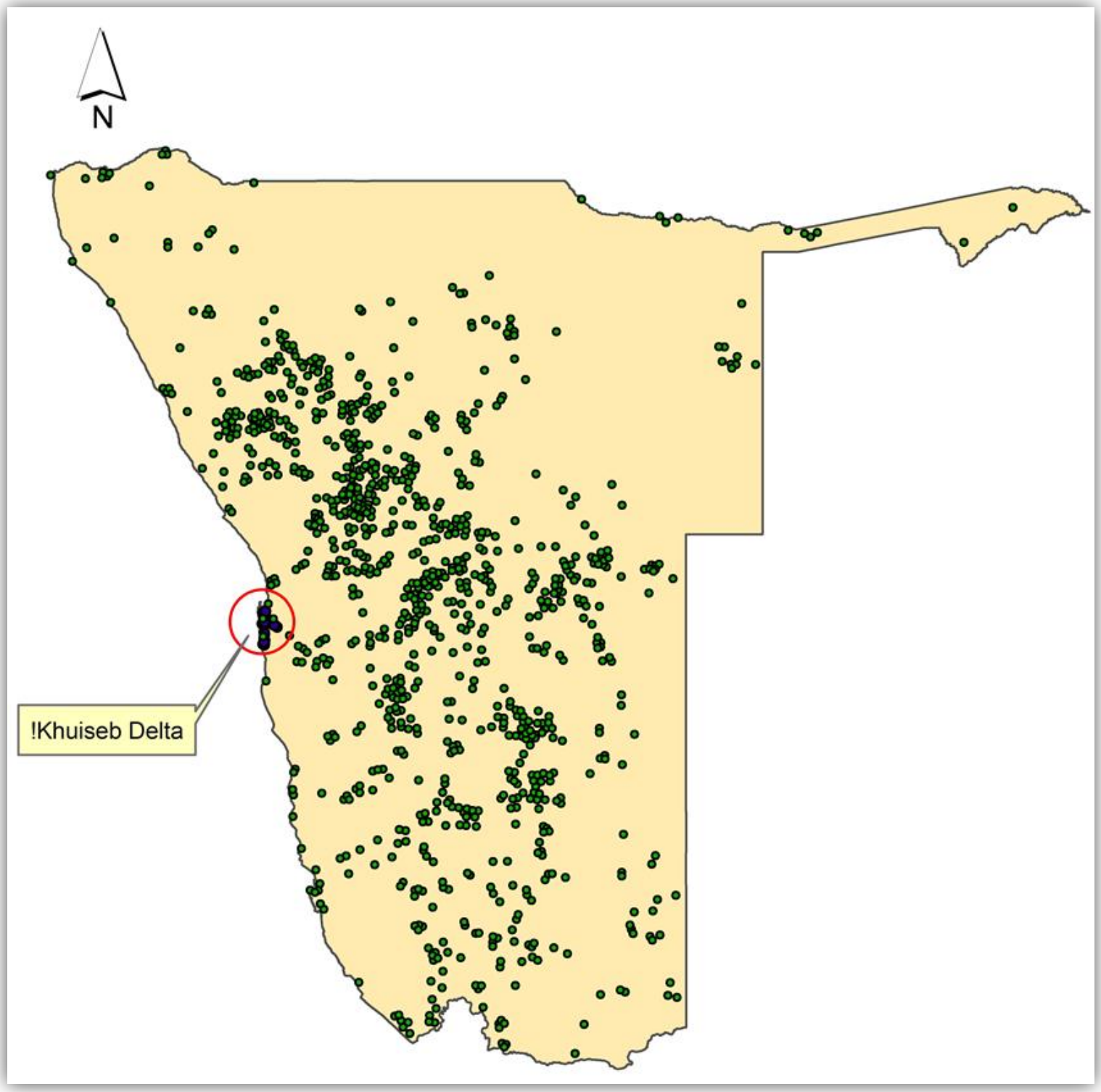


Figure 6.13: The regional setting the !Khuiseb Delta, showing the distribution of archaeological sites in Namibia and the relatively low density of sites along the coast.

6.4.2 Archaeological Sequence

Archaeological investigation of the areas described above has yielded no trace of human occupation older than 2, 000 years (Fig. 6.14). However, evidence from archaeological sites inland of the !Khuiseb Delta spans a sequence covering the last 12, 000 years. The apparent absence of human settlement in this area during the first 8, 000 years of the Holocene period is striking. A number of possible explanations are suggested by the evidence from the !Khuiseb and from the surrounding region, and these are as follows:

- The physical setting of the !Khuiseb Delta sites is itself composed of very young features, such that the delta, lagoon and immediate shoreline may be not much older than 2, 000 years;

- The physical conditions (wind and high moisture levels) may ensure that archaeological evidence is continuously exposed to attrition and other destructive effects of weathering, so that older evidence would not have survived;

- The first 5 - 6, 000 years of the Holocene are characterized by very limited evidence of human settlement in the Namib as a whole, so that the absence of occupation dates from that period in the !Khuiseb Delta is not exceptional;

- Evidence from the Namib as a whole suggests a steep increase in human population during the last 4, 000 years, and this may have led to more intensive occupation of the coast only in the last 2, 000 years.

It is very likely that the patterning in the radiocarbon dating of the !Khuiseb Delta sites is due to a combination of these factors. The physical landscape is indeed highly dynamic and subject to constant change; the physical conditions are also inimical to the preservation of archaeological materials exposed on the surface, a phenomenon that is discussed in more detail in the next section. The early Holocene hiatus in the Namib archaeological sequence is controversial, but the evidence favours the possibility that the population of this region largely collapsed during the late Pleistocene Last Glacial Maximum (LGM) and that it did not immediately recover with the restoration of Holocene climatic conditions 10, 000 years ago. Allied to this argument is the evidence suggesting that occupation of the coast and reliance on its resources was a recent development which may have arisen in response to population pressure in the desert interior.

Within the !Khuiseb Delta area there were significant shifts in the focus of human settlement over the last 2, 000 years. These shifts relate to changes in ecological requirements with the acquisition of domestic livestock approximately 1, 000 years ago, followed by two further important shifts: one in which the ǂAonin positioned themselves to best advantage as European traders began to visit Walvis Bay, and a second shift as ǂAonin who no longer owned livestock moved to Sandwich Harbour in search of employment or charity from European fishing operations (Fig. 6.14).

The first evidence of human settlement approximately 2, 000 years ago is concentrated around Frederiksdam, with some occupation at Sandwich Harbour. By 1, 000 years ago, Sandwich Harbour was abandoned, presumably due to the lack of suitable grazing, and settlement was concentrated in the Walvis Bay dunefields, with cattleposts located within 50 km upstream on the !Khuiseb River. This pattern continued for several centuries and by the early 18th century settlement in the Walvis Bay dunefields was characterized by the presence of a small number of large semi-permanent sites. In the mid-19th century when the pastoral economy was in decline, impoverished ǂAonin moved to the edges of European fishing camps at Sandwich Harbour and remained there until the end of the century.

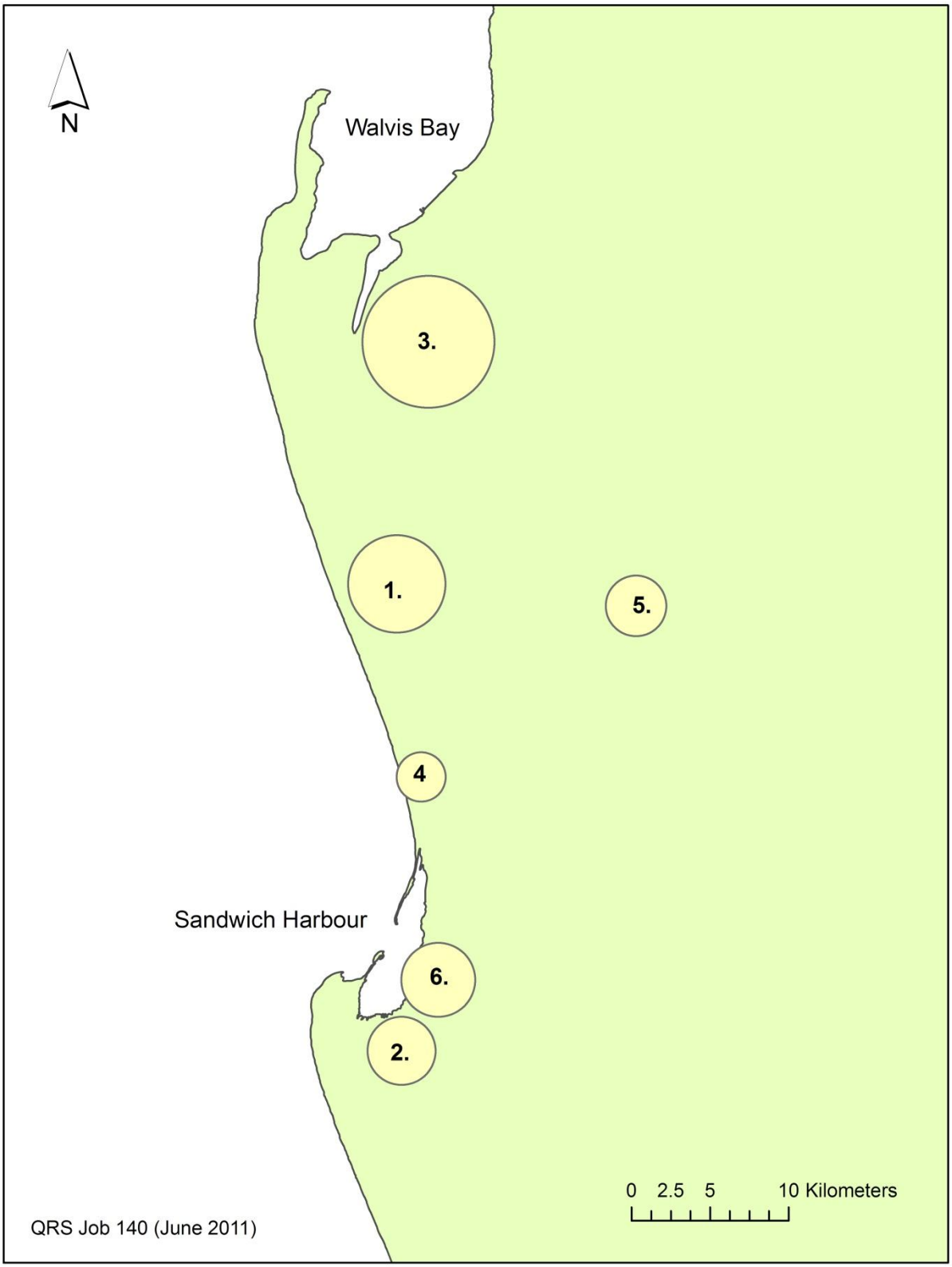


Figure 6.14: Sequential shifts in the focus of human settlement during the last 2, 000 years in the !Khuiseb Delta: 1. & 2. Frederiksdam and southern Sandwich Harbour, large shell middens occupied prior to the introduction of domestic livestock; 3. Walvis Bay dunefields as main focus of settlement during the 18th and 19th century trading contact with European ships; 4. & 5. Gorogos and Khaeros, cattleposts used to supply the Walvis Bay trade; 6. Sandwich Harbour fishing enterprises as focus of indigenous settlement after the late 19th century collapse of the pastoral economy (this period also saw an increased density of settlement in the Walvis Bay dunefields).

6.4.3 Site Formation Processes

The preservation and visibility of archaeological sites in the !Khuiseb Delta is overwhelmingly influenced by two major forces: the periodic flooding of the !Khuiseb, which carries large volumes of silt into the delta area, and the prevailing southwesterly wind, which deposits large volumes of aeolian sand across the drainage lines of the !Khuiseb. The net effect of these two processes is to create a mosaic of isolated silt deposits, surrounded by mobile dunes. These dunes move in a generally north-easterly direction, burying the silt deposits and their archaeological remains for several decades at a time. The silt deposits are also subject to gradual deflation by the wind, so that archaeological material is left on the surface of the silt as a lag deposit. Human skeletons, for example, are found fully flexed and articulated, lying on the surface of the silt, preserved in the position of their original burial.

Moisture and wind attrition have a highly destructive effect on archaeological remains lying exposed on the surface under such conditions. Soil moisture in The !Khuiseb Delta is highly saline, and moving upward by capillary action is absorbed by any porous or semi-permeable material on the surface. Thus, bone, pottery and even slightly fractured stone cobbles may become superficially or even entirely soaked. The moisture evaporates under the high surface temperatures of the dunefields and the dissolved salts re-crystallize, exerting considerable mechanical force along any natural fracture, splintering bone into ever smaller pieces. Pottery tends to fracture very easily under these conditions, and the abrasive effect of the windblown sand can reduce well-fired clay to paper-thinness.

The most durable material found on archaeological sites in the !Khuiseb Delta is marine shell, the discarded remains of species such as *Donax serra* which contributed a large part of the human diet during the first phase of occupation. Although robust shell such as *Donax* does not crack easily and hardly absorbs moisture, it, too, is eventually destroyed by a process of attrition in which the shell is broken by wind-driven impact on adjacent shell fragments. This eventually reduces the shell to fragments small enough to be lifted and transported by the wind. Under these conditions, entire shell middens of several thousand square metres extent, are eventually reduced to thin streaks of tiny shell fragments on the windward side of dunes more than 100m downwind of their original position. The process described here is well illustrated by the surface plan of one site in the Frederiksdam area, shown in Fig. 6.15.

Conditions in the !Khuiseb Delta are sometimes surprisingly favourable for the preservation of archaeological evidence, and this is best illustrated by the occasional survival of human and animal tracks in the surface of the colluvial deposits. Two kinds of deposits may be distinguished here: fine river silts, found mainly in the core zone of the Walvis Bay dunefields and parts of the lower !Khuiseb, and lagoon silts, on the eastern margins within up to 2 km distance of the existing tidal lagoon. The river silts have several examples of animal spoor, including elephant, oryx, zebra and ostrich, evidently made on the edges of muddy pools that became temporary drinking places. The lagoon silts have a more complex depositional history: high tides filled temporary impoundments of highly saline water, reduced under evaporation to a saturated solution of gypsum, anhydrite and related minerals. In the latter case, spoor were preserved in the very hard, cement-like surface of the dried sediment. Examples of spoor dating to within the last 300 years have been found in several parts of the delta, and in both kinds of sediment.

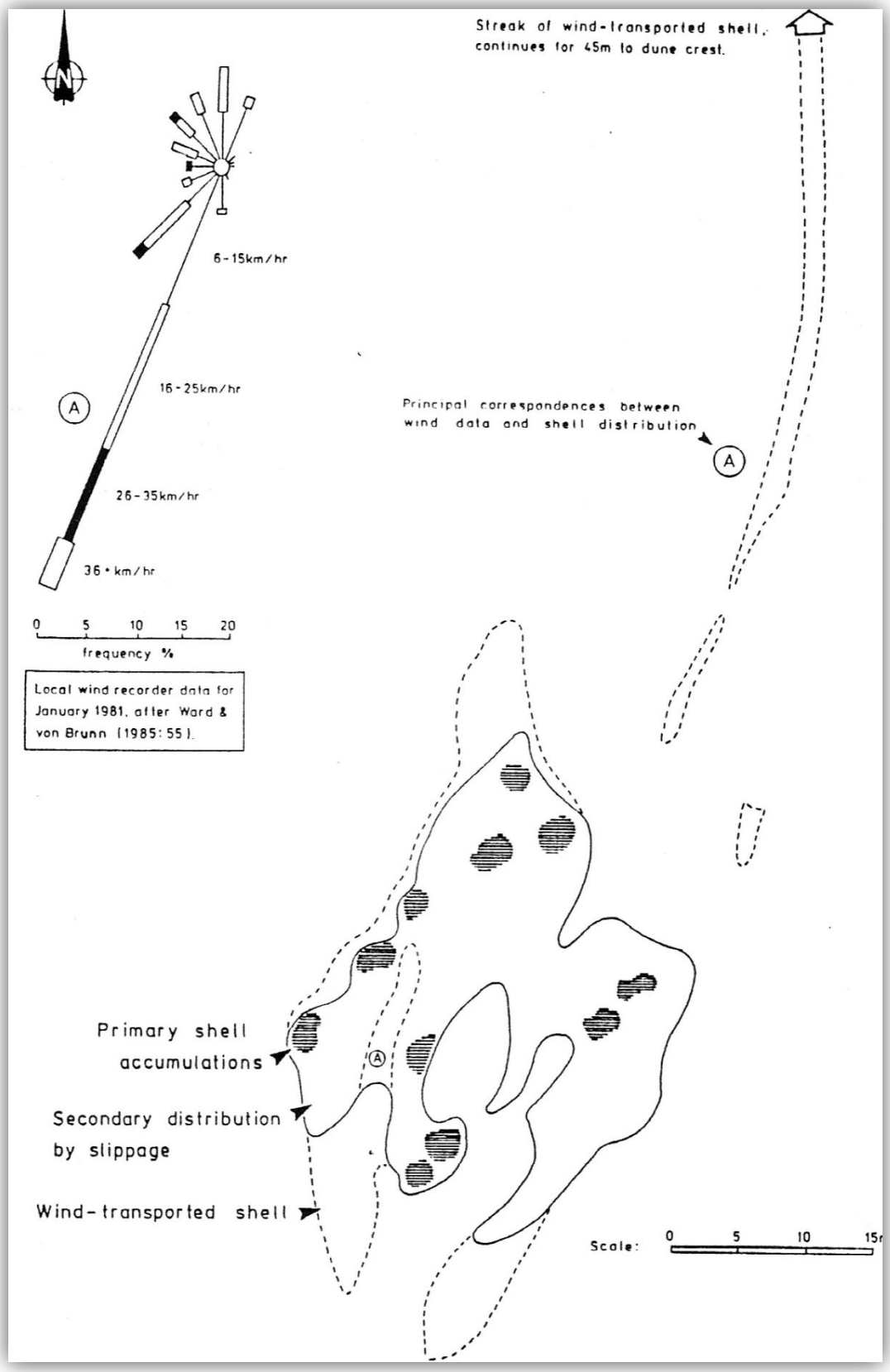


Figure 6.15: Diagram to illustrate the effect of the prevailing southwesterly wind (see windrose, top left) on a large shell midden dating to the early first millennium AD. The midden comprises a cluster of eleven discrete heaps of *Donax serra* shell, discarded on the surface of the sand dune. The bold line enclosing the shell heaps shows the distribution of shell displaced by the collapse of the middens, while the broken line indicates displacement that corresponds to wind direction, here dominated by the prevailing southwesterly wind. The linear streak of shell fragments aligned to the northeast is evidently the result of this process of wind-driven attrition.

6.4.4 Situation Analysis

The !Khuiseb Delta is a highly dynamic environment which does not generally favour the preservation of archaeological evidence. The combined effect of the river flow regime and of very strong prevailing winds is to degrade and displace archaeological materials, making them difficult to locate and to document. In spite of these conditions a number of detailed archaeological studies have been carried out during the last few decades (Fig. 6.16). These have documented the process of human settlement in the delta and the nature of human adaptation to the various resources it offers (Fig. 6.16). The archaeological studies have also documented the process of contact, trade and eventual domination of indigenous communities by European traders and, eventually, colonists who established the modern settlement of Walvis Bay.

The archaeological work carried out so far in the !Khuiseb has documented a relatively small part of the material evidence and removed from the area for study only a very small amount of material. In the more than twenty years since these studies were carried out, access to the dunefields has greatly increased and the sites, once considered safely remote from disturbance, are now under serious threat and there is a real possibility that some of Namibia's most valuable archaeological sites will be lost.

6.4.5 Archaeological Knowledge Asset Value of the !Khuiseb Delta

6.4.5.1 Implications of Minimum Collection Strategy

In the early 1980's, ten years before the advent of GPS navigation, archaeological survey was greatly limited by the small scale of available topographic maps and the difficulty of determining the exact position of archaeological sites on the ground, especially in areas with unrelieved topography such as the !Khuiseb Delta. The surveys which formed the basis of the main investigations carried out in the delta used a combination of compass traverses, distance estimates and triangulation on visible features. There are relatively few suitable features for position triangulation in the delta and site location depended almost entirely on the field skills of the archaeologist. In spite of heavy security restriction, large scale aerial photographs were obtained and these proved very useful although without georeferencing they could not be used to measure position co-ordinates.

The field positions of archaeological sites in the delta were determined by the combination of methods described above, and in some cases permanent datum pegs (30 x 30 mm pine with aluminium tags) were left on the sites. This was done mainly for two reasons: as a control point for the surface mapping grid used on the site, and as a control point from which to measure the movement of surrounding dunes. On the sites, large and complex surface scatters were mapped by hand using a 1m square string grid and a plotting frame subdivided to units of 0.1m. In this way accurate maps were made of surface artefact scatters and these were used to determine the layout of sites and the positioning of various activities such as butchery, fish processing and so on.

Systematic controlled surface collections were made only where necessitated by requirements to remove material for analysis, dating and identification. In general, as little as possible was removed from the sites so that subsequent studies by other archaeologists could proceed from a point where minimum disturbance had occurred. The material removed from the sites was accessioned into the archaeology collection of the National Museum in Windhoek, together with accompanying documentation and copies of all reports and publications resulting from the site investigations. An unantipicated result of this minimum collection strategy was that the sites eventually became vulnerable to disturbance and large-

scale pilfering of objects such as pottery, glass trade beads and human remains. Once removed from their original context such objects lose almost all archaeological value and the knowledge asset value of the !Khuiseb Delta archaeological sites is greatly reduced.

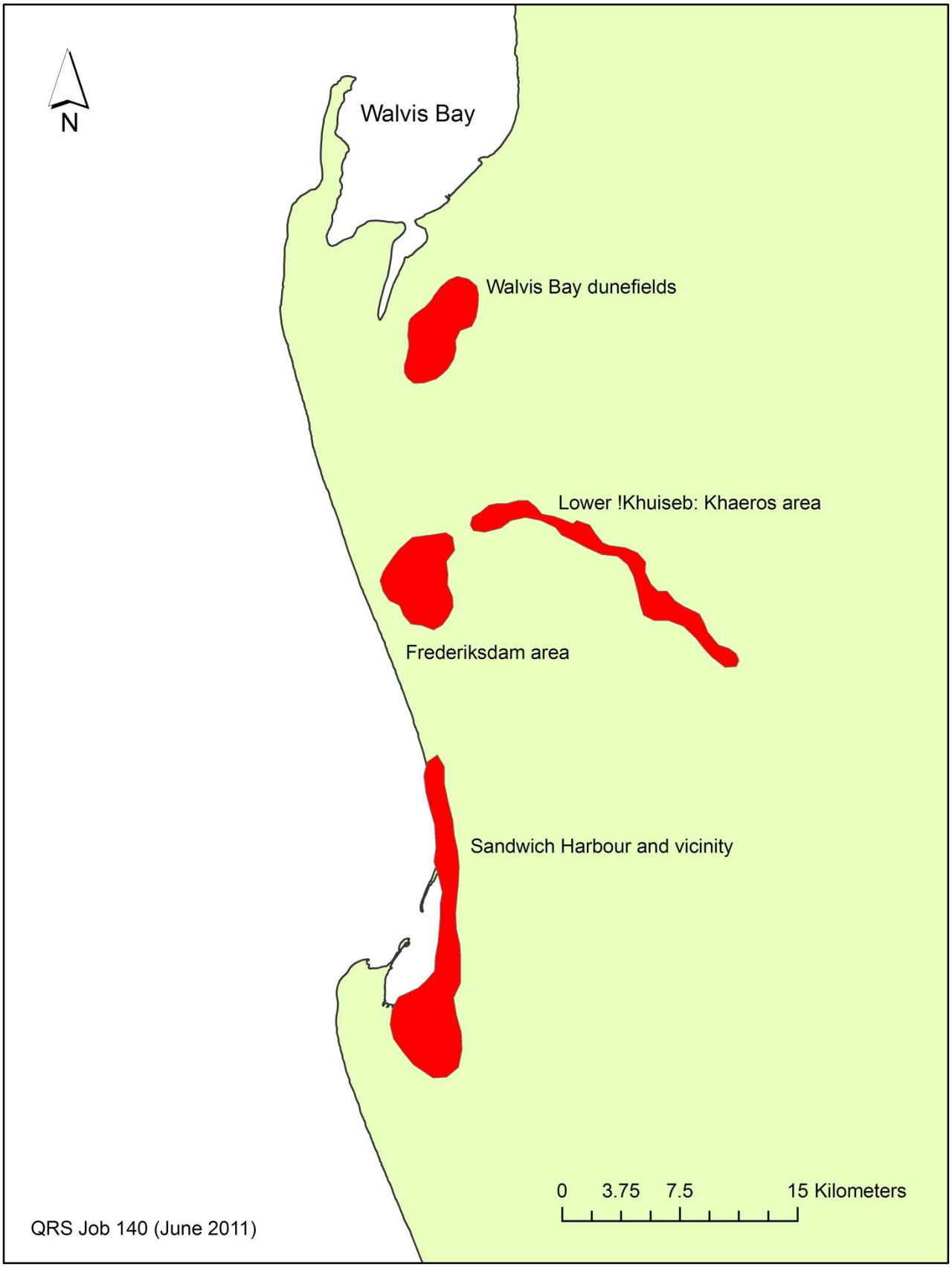


Figure 6.16: Major archaeological and historical site concentrations in the !Khuiseb Delta.

6.4.5.2 Global Comparisons

The expansion of merchant capital from Europe began in earnest during the seventeenth century, with the great voyages of discovery leading to the establishment of global trading networks that were the prelude to colonial settlement in Africa, the Americas and Australia. Major trading entrepôts were invariably in coastal locations with suitable anchorage, fresh water and other resources, sites that were usually centres of indigenous settlement. These sites in most instances became bridgeheads of colonial occupation and, as they grew, their expansion tended to obliterate all trace of their earlier history. Building, road construction and other developments simply destroyed the often very subtle and meagre traces of the contact between indigenous communities and the outside world at that time.

In the global history of early colonial contact Walvis Bay is probably unique. There was intensive contact from the early 18th century when American whalers visited the bay, and so favourable were their reports that Walvis Bay was seriously considered as a site for a British convict settlement. The expedition of HMS *Nautilus* in 1786 decided that Walvis Bay was too inhospitable a site, its poor water supplies being a major disadvantage, and the alternative choice of Botany Bay, Australia, prevailed. The British did however annex Walvis Bay, but only as a strategic measure to limit German control, and for this reason the port did not develop as a major point of access during the early colonial period. As a result of these events, the settlement of Walvis Bay grew very slowly during the entire colonial era and did not encroach on the dunefield area that is the core zone of the archaeological site distribution.

According to the documentary records of early trading contact at Walvis Bay, the ǂAonin were enthusiastic partners in the initial exchange of livestock for trade items such as glass beads and other commodities. Inevitably there were misunderstandings and conflicts, and as a result, the ǂAonin adopted a more cautious approach. The records state that ships would be made to wait several days before the livestock they requested was brought down to the beach. The Europeans were not permitted to go beyond the first line of dunes, where sentinels were posted to warn the people of any unwelcome approach. The delay of several days reported in shipping records is consistent with the distance between the main trading settlements in the Walvis Bay dunefields, and the cattlepost sites that lay more than 50km inland.

The indigenous cattle economy collapsed in the late 19th century, when the devastation of the *Rinderpest* epidemic followed decades of internecine raiding and increasing economic domination by early European settlers. As the economic independence of the ǂAonin dwindled, and their herds were reduced to almost nothing, many people moved to the mission stations and the fringes of European settlements and fishing enterprises. Settlement in the Walvis Bay dunefields changed accordingly; the large trading settlements were replaced by small, scattered homesteads which lay within reach of the new harbour town of Walvis Bay. The extreme state of poverty experienced by the ǂAonin has been described by several commentators of that time, and as the people abandoned their settlements, these remained as material – archaeological – testimony to the historical events of the last three hundred years, a unique record that hardly exists anywhere else in the world.

6.4.5.3 Research Prospects

The great value of the archaeological evidence from the !Khuiseb Delta is that the indigenous, or ǂAonin sites, provide a counterpart to the documentary record based on the observations and recollections of early European visitors. In almost no instance prior to the residence of missionaries in the late 19th century, were European visitors able to

communicate with the ǂAonin. The documentary record of the time is therefore entirely based on the European view, lending a strong bias to any account of the relations that existed between the two peoples. This one-sidedness of the historical record has retarded investigation of early trading contact everywhere in the world, and in most cases, as outlined above, there is no material trace of the indigenous communities of the time.

The detailed archaeological research carried out during the last twenty years in the !Khuiseb provides a very unusual reconstruction in which the comments of the European visitors can be contextualized by archaeological evidence from the settlement sites of the ǂAonin. For example, this research has established in considerable detail the settlement patterns, demography and dietary habits of the ǂAonin at that time. It has also established the material cultural character of ǂAonin society and traced the effect on this society following the introduction of exotic trade goods. The archaeological record has also revealed the nature of cultural preferences exercised by the ǂAonin, who were apparently highly selective in the range of trade goods they would accept in return for their livestock.

More wide-ranging archaeological research in the adjacent hinterland has helped to reveal the links between the !Khuiseb Delta trading sites and other communities, as the people of the Namib coast became absorbed into the world economy. The archaeological record shows that this was not a one-sided process in which the ǂAonin were simply absorbed and subordinated by mercantile capital, although the effect of this unequal trading relationship was such that the European economy did eventually prevail. Much more detailed research could be carried out in the !Khuiseb Delta, as the evidence has shown that it is possible to investigate a wider range of issues than has been addressed so far.

Research prospects in the !Khuiseb Delta are ultimately dependent on the state of preservation on the sites and the degree to which they can be treated as undisturbed repositories of evidence. Among the most enticing prospects are the opportunity to investigate changes in the demography, dietary status and health of the ǂAonin community through the history of contact and trade. Usually, this process imposes severe stress on maternal health, reproductive success, infant survival and the age of mortality in the mature population. The !Khuiseb Delta provides ideal circumstances to investigate these issues using the large quantity of exposed human remains found there. Provided that such research is acceptable to the descendents of the earlier community, it could prove useful and instructive.

Other research possibilities include more detailed work on the remains of domestic livestock found on the archaeological sites. The genetic character of the cattle, sheep and goat varieties involved in this early trade are practically unknown and such investigations would help to establish some of the wider links between the animals traded at the coast and the livestock holdings of farming settlements elsewhere in Namibia. There are also numerous possibilities for other research on the interior links of the coastal trading economy, such as the origins of copper and iron that formed the indigenous precursor of the European-initiated trade in glass beads and other imported goods. Reconstruction of such trading networks would contribute much to an understanding of the late pre-colonial economy of Namibia.

6.4.5.4 Legal Status

Under the National Heritage Act (27 of 2004) the archaeological remains in the !Khuiseb Delta are defined as national heritage and therefore enjoy legally protected status. The implication of this protected status is that the archaeological sites and their contents are the property of the nation; they are not the property of the local community or any other party. Protected status means that under the terms of the Act, it is an offence to disturb or remove

any item of archaeological significance. The use of an archaeological site for any purpose, including recreation or tourism, is subject to the granting of a permit by the National Heritage Council.

Archaeological sites and objects have been legally protected in Namibia since the 1960's, under the provisions of the National Monuments Act, repealed by the National Heritage Act of 2004. In reality, neither the National Monuments Council nor the present National Heritage Council exert any active control over the area and have not (to the knowledge of the writer) made any attempt to inform the public of the importance of the sites or the need to protect and manage them. To the knowledge of the writer, the Council has not participated in any of the various initiatives that have been taken to improve the conservation of coastal environmental resources, even though it is well known that these include important archaeological sites.

Official neglect of the !Khuiseb Delta archaeological sites also extends to other arms of government such as the Ministry of Environment. In the case of the present NACOMA project it appears that interest in the archaeology of the delta is based on its possible value as a tourism commodity rather than its value as a knowledge asset, as described above. Unfortunately the reversed priorities approach that has brought the archaeological resources of the delta under environmental scrutiny for the first time has the result that tourism initiatives in the delta (both commercial and community based) have advanced to the point where it would be difficult to impose limitations that would not inconvenience these interests.

One possible solution to what has become an ad hoc development process is to engage with the National Heritage Council and all interested and affected parties to have the !Khuiseb Delta proclaimed as a Conservation Area under Part VI, Section 54 of the National Heritage Act. This would serve to acknowledge the heritage value of the delta (or the part of it defined by application) and to formalize the activities of the various interested parties within the framework of a management plan formulated by mutual consultation. It must be emphasized, however, that the involvement of interested parties in the proclamation process does not automatically means that their activities are approved as acceptable elements of a sustainable land-use plan.

The process towards Conservation Area status is a constructive way to involve all parties and develop cooperative management strategies. Because this process may require many months to complete, it would be advisable for all the interested parties to place their activities on a legally sound footing, by obtaining permits from the National Heritage Council to continue with their various enterprises. This way, all parties involved in the Conservation Area process would be assured of having a recognized status as both operators in the delta archaeological landscape and as participants in the process of Conservation Area proclamation. The next section of the report reflects more directly on the impact of various activities in this area and argues that the use of the !Khuiseb Delta for tourism purposes is difficult to justify given the unique heritage value of the sites. This concluding section of the report therefore attempts to define some clear limitations on the scope of tourism activities and suggests a significant down-scaling of present impacts in order to preserve the sites from damage.

6.4.6 Current Use of the Area and its Heritage Resources

6.4.6.1 Lack of Protection Measures

Public awareness campaigns and stringent regulations now exist for the conservation of fauna, flora and the general environment of the Namibian coast. The combination of appropriate legislation and effective public education has not however addressed or explicitly

included the need to conserve the cultural heritage of the region. A general lack of awareness exists among otherwise dedicated conservationists as well as the authorities charged with heritage conservation. There is a long history of neglect; in the pre-Independence era the archaeological record of Namibian history was accorded little importance. Among conservationists, the presence of settled communities in protected areas was anathema, and concerted attempts were made (unsuccessfully) to remove the ǂAonin from the Namib Naukluft Park. It is the combination of these oversights and tacit agreements that have ensured a generally low appreciation of the !Khuiseb Delta and its archaeological resources.

The growth of tourism in Namibia over the last twenty years is generally applauded as a source of employment and income, especially for previously marginalized communities. Community-based tourism continues to receive very significant financial assistance, with the addition of enterprise development training, legal protection of business interests and capitalization of infrastructure such as camps and office equipment. In a number of instances these enterprises are to a large extent based on the attraction value of cultural heritage sites, particularly rock art. However, in most cases the financial support of these enterprises is not accompanied by any training in the sustainable management and conservation of cultural heritage resources. As a result, many valuable rock art sites that would be valuable tourism assets have been degraded to the point where they have very little attraction value and the one truly unique asset that would give a community tourism venture a lasting source of income is irretrievably lost.

Similar problems attend the development of commercial tourism based wholly or partly on cultural heritage sites. In fact, almost no control or oversight is exercised over cultural heritage site tourism by the National Heritage Council. Tourist camps, lodges and other facilities are built without regard to their impact on archaeological sites and in very few instances have commercial or community-based developers had to carry out archaeological impact assessments or mitigation work in relation to their activities. These are routine requirements of mineral exploration and mining projects as well as projects to supply infrastructure needs to the mining industry. In the Erongo Region, the tourism industry has had a measurable greater negative impact on the cultural heritage of Namibia than has the mining industry, and while the mining industry is answerable to the authorities and general public, the tourism industry is manifestly not. These issues concerning the pack of protection measures are important background to the discussion to follow.

6.4.6.2 Traditional Ownership Rights

The most important object of archaeological research in the !Khuiseb Delta is to document the human history of the area and to restore the historical record of communities such as the ǂAonin which has been largely degraded and neglected. In carrying out this research, the Namib Desert Archaeological Survey in particular, has consulted closely with the ǂAonin leadership and has assisted in various capacities. These tasks have included the provision of archaeological background information to technical bodies such as the “Kuiseb Basin Management Committee”, provision of archaeological assessment capacity to mineral exploration projects, direct assistance to the “Kuiseb Delta Development Trust” in the drafting of project proposals, and advice to consultants charged with the development of community-based tourism business plans for the ǂAonin.

Ownership rights with respect to the resources of the !Khuiseb Delta appear to be complicated, not only by the particular mix of freehold and state ownership of land, but also by the mix of formal and informal resource ownership. On the one hand, State land in the !Khuiseb Delta area is largely designated as national parks, with strict prohibition on the

consumption of natural resources. On the other hand, within the Namib Naukluft Park the ǂAonin enjoy uncontested rights of occupation and usufruct, especially in respect to the !nara fields. Concerning the ownership of cultural heritage (of which the use of !nara is one aspect), the ǂAonin own their history – in the form of its narrative – but they do not own the material record, over which the National Heritage Act assert rights of ownership on behalf of the nation. The purpose of this short discussion is to point out these complexities, not to resolve them.

In respect to these general issues, the role of the Namib Desert Archaeological Survey is to document and study the archaeological record of the area; to make the Namibian authorities and general public aware of this invaluable record; to publish research findings in both the academic and popular literature, and to introduce these results to the mainstream of archaeological discussion about the global processes of early trading contact and the eventual domination of indigenous economies by mercantile capital.

6.4.7 Impact of Tourism Activities

The project proposal is uninformed as to the archaeological value of the area and has used archaeological survey data merely as an aid to identifying the most commercially advantageous position for the project. The project is a community-based enterprise, but its formulation is no different from that of commercial tourism projects that fail to consider the potential impact of their activities. In this way, the Kuiseb Delta Development Project proposal represents a "worst case" scenario for the management and conservation of this archaeological landscape (Figs. 6.17 and 6.18). The fact that it is supported by organisations such as NACOMA and evidently the Ministry of Environment, without the National Heritage Council demanding better controls, merely illustrates the institutional threats that are posed to the archaeological record in Namibia.

Tourism-related impacts are considered not in isolation but as one of several concurrent and related threats all stemming from the increasing intensity of recreational and other activities in the area. The main threats to the archaeology of the !Khuiseb Delta are as follows:

(i) **Uncontrolled tourism:** The greatest threat comes from uncontrolled tourism and recreational use of the Walvis Bay dunefields, Sandwich Harbour, Frederiksdam and the delta as a whole. People ignorant of the value of the archaeology may not recognize archaeological artefacts, drive over sites, crushing material and destroying its context, often coming back again and again to the same place. They pilfer items as curiosities or keepsakes, sometimes on a large scale, as bottle collectors do. The destruction or removal of material without documentation greatly reduces not only the value of the site but also of the artefact;

(ii) **Unrestricted access:** Increasing ownership of 4x4 vehicles and quadbikes, together with tour companies that hire these vehicles allows a great number of people seeking recreation access to areas of special archaeological significance.

(iii) **Municipal activities:** Urban expansion, dune control measures, roadworks, construction of culverts and drainage channels all affect the archaeology;

(iv) **Commercial activities:** The saltworks at Walvis Bay expand their roads and pans, and bring a high volume of heavy vehicle traffic in and out of the area. One of the largest shell middens on our coast, Wortel, was situated here and has been completely destroyed. Fortunately, the site has been documented and researched.

(v) **National Park activities:** Maintenance of the park and its roads, rubbish collection, borrow pits, and inappropriate siting of facilities can pose considerable threats to archaeological sites. Picnic sites deserve special mention because a number of important sites in the archaeological landscape have been made into public picnic sites. There is heavy visitor traffic which raises dust, compacts the ground, and introduces rubbish and ash from fires, degrading the site. Site maintenance carried out by park officials can also be destructive: trucks collecting rubbish, and cleaning up by raking can disturb the distribution of archaeological material. The siting of picnic spots at archaeological sites is in itself inappropriate without proper site caretakers and supervision;

(vi) **Mining:** The activities of exploration companies are now controlled by the issuing of licences dependent upon compliance with environmental and archaeological legislation. Mine safety legislation requires strict control of the area under licence, so that access is tightly controlled. However, drilling and trenching, construction of roads and camps, and misguided rehabilitation such as raking and sweeping of ground still pose threats. These risks are alleviated by having archaeological survey and assessment professionally done;

(vii) **Private ownership:** Although access is restricted and thereby protects the archaeology on farmland, land owners and farm management should be aware of legislation protecting national heritage and take appropriate measures to protect and maintain any archaeological sites, especially if undertaking tourist related activities;

(viii) **Natural weathering:** The nature of the archaeological sites on the coast and their abundance of material make them vulnerable to natural processes. The dunefields are created and maintained by natural agents including wind and river flooding, but the archaeological remains are exposed on the surface and can be sandblasted, buried, or washed away. Pottery and bone can be scoured paper thin, glass crackles and “sickens”, metal rusts and crumbles to dust and the weight of dunes can distort or crush bone and artefacts. In spite of these natural hazards, the amount of material preserved is remarkable and this threat is not as great as that posed by uncontrolled human agency;

(ix) **Research:** The presence of the Desert Ecological Research Unit at Gobabeb in the lower !Khuiseb introduces some threat to the archaeology of the area, such as uncontrolled driving across the plains, and the construction of buildings in the archaeological landscape. Archaeological research that involves collection and excavation is by nature a form of controlled destruction;

(x) **Siting of new Topnaar settlements and structures:** The significance of the archaeology is paramount to the Topnaar people. The archaeology is a material record of their history and provides evidence of their cultural practices such as the harvesting and processing of !nara melons and marine resources, for which exists specific botanical and ecological knowledge and skills, traditions, praise poems, property rights, stories and memories. There are direct links between the people, their knowledge, and this area. However, they are a presence in the area and their activities should be carried out with awareness of the fragile archaeology;

(xi) **Siting of tourist facilities:** The siting of the proposed tourist camp and related facilities of the Kuiseb Delta Development Project is a case in point. The infrastructure is sited in the most sensitive part of the archaeological site distribution, where it poses as direct threat to these invaluable remains (Figs. 6.17

and 6.18). The project was planned without any apparent consideration given to the vulnerability of the sites, and follows the now established (negative) practice of siting infrastructure and other facilities as close as possible to the attraction.

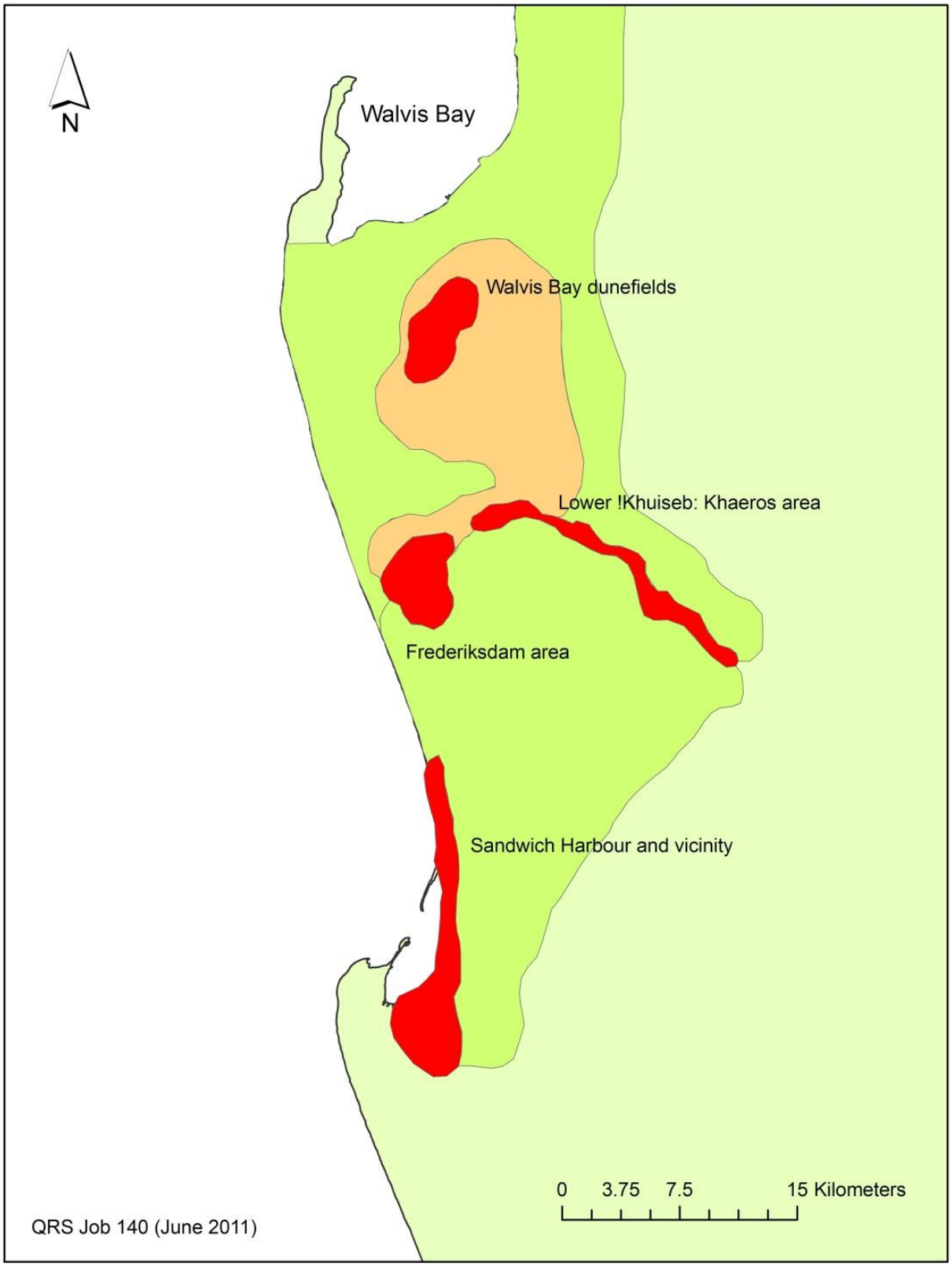


Figure 6.17: Archaeological sensitivity mapping of the !Khuiseb Delta: RED indicates highly sensitive areas; PINK medium sensitivity area, and GREEN low sensitivity area. High sensitivity areas contain up to 50 archaeological sites per km^2 and contain evidence that is essential to the understanding of the regional sequence; medium sensitivity areas contain up to five archaeological sites per km^2 and contain valuable contextual evidence that is necessary to the understanding of local settlement hierarchies; low sensitivity areas contain less than one archaeological site per km^2 and these are usually of limited research potential.

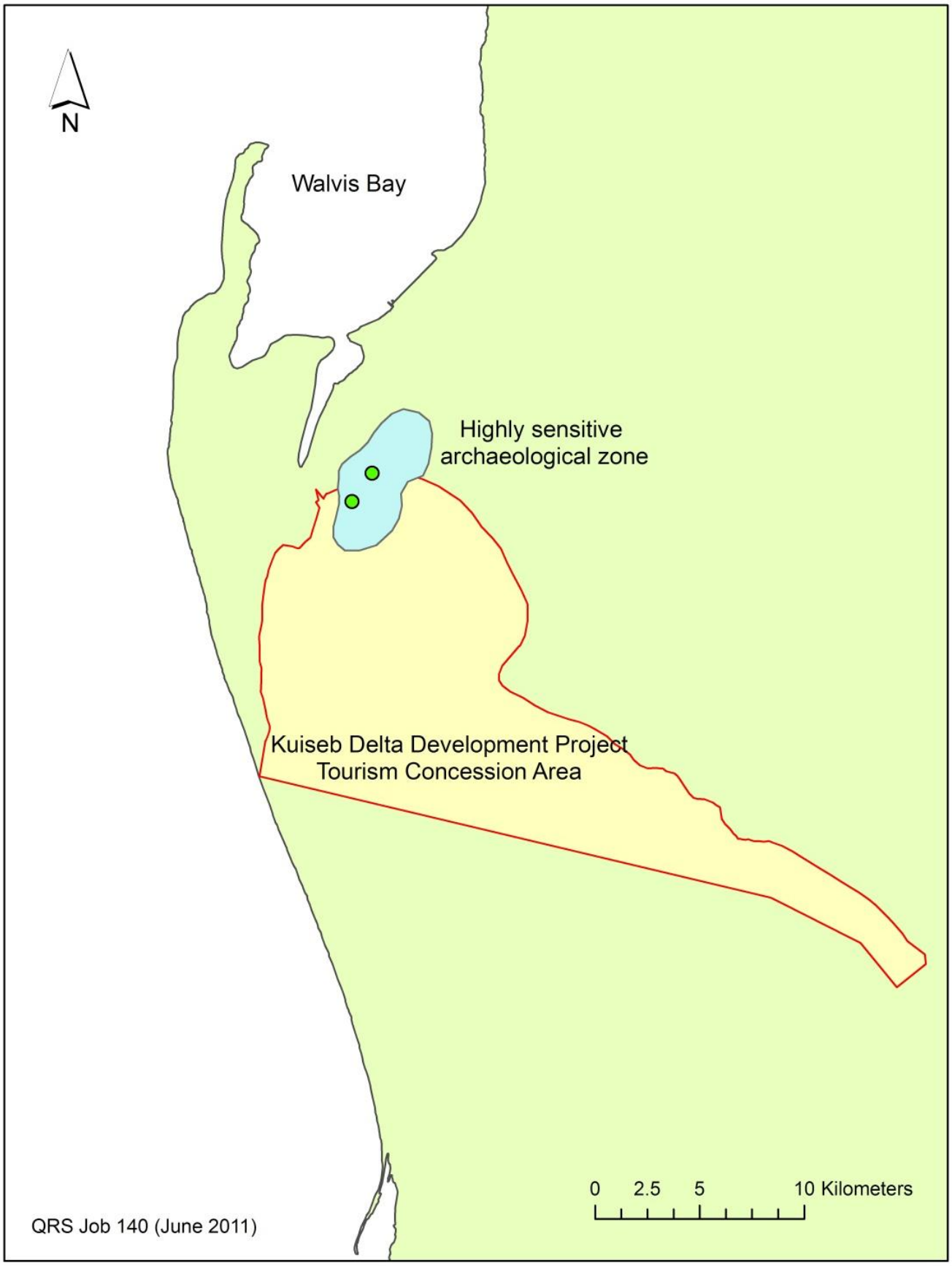


Figure 6.18: DST for the Kuiseb Delta Development Project: tourism concession area in relation to sensitive archaeological zone. The two green circles within the sensitive archaeological zone are the sites of the proposed lodge and campsite for the Tourism Concession Area.

6.4.8 Management and Conservation Proposals

To limit the impact of the various threats outlined in the previous section it is necessary to formulate and implement an effective management plan for the archaeology of the !Khuiseb Delta. The Conservation Area proclamation of the delta would provide the necessary formal framework for this process, although it is most important that the management plan should be developed in a consultative fashion so as to accommodate all stakeholders views (Fig. 6.19). At the same time it is very important that the management plan for the delta should place the importance of the archaeological sites at the head of the agenda, along with the most critical principles of site management. The ultimately unsatisfactory alternative to this approach is a management plan that places the commercial and related interests of the stakeholders at the head of the agenda, compromising on the sustainable use of the sites.

The critical principles that should inform the management plan framework are as follows:

(i) The archaeological sites of the !Khuiseb Delta are an invaluable and globally significant heritage resource;

(ii) This heritage resource is the common property of the Namibian nation, rather than of any individual party;

(iii) All use of the area, particularly for tourism and other recreational purposes, should be subordinate to the preservation of the sites;

(iv) In principle it is not necessary to physically visit and sensitive archaeological site in order to appreciate its significance;

(v) Any access to archaeological sites should be strictly monitored and subject to specific guidelines as to routes, group numbers and other factors;

(vi) No camping or other overnight facilities should be permitted in any area designated as archaeologically sensitive;

(vii) All areas and routes should be subject to detailed field assessment with the option to have permission withheld.

The vision for sustainable archaeological tourism in the !Khuiseb Delta emerging from this assessment is as follows:

(i) The archaeologically significant part of the !Khuiseb Delta would be proclaimed as a Conservation Area under the National Heritage Act (Fig. 6.19);

(ii) The Conservation Area as outlined in Fig. 6.19 would be managed by a group of interested parties informed by the principles of sustainable tourism and archaeological knowledge;

(iii) There would be a single, preferred point of access to the Conservation Area via a purpose-built information centre and museum;

(iv) The traditional community of the !Khuiseb Delta would be closely involved and economically integrated in the management of the Conservation Area;

(v) Visitor experience of archaeological remains would be achieved via well designed and informative displays rather than walking on the sensitive sites themselves;

(vi) Guided access to the Conservation Area would concentrate on exposing the visitor to the physical world of the delta, including its setting, texture and natural resources;

(vii) No facilities such as campsites would be sites within the Conservation Area or near to sensitive archaeological sites.

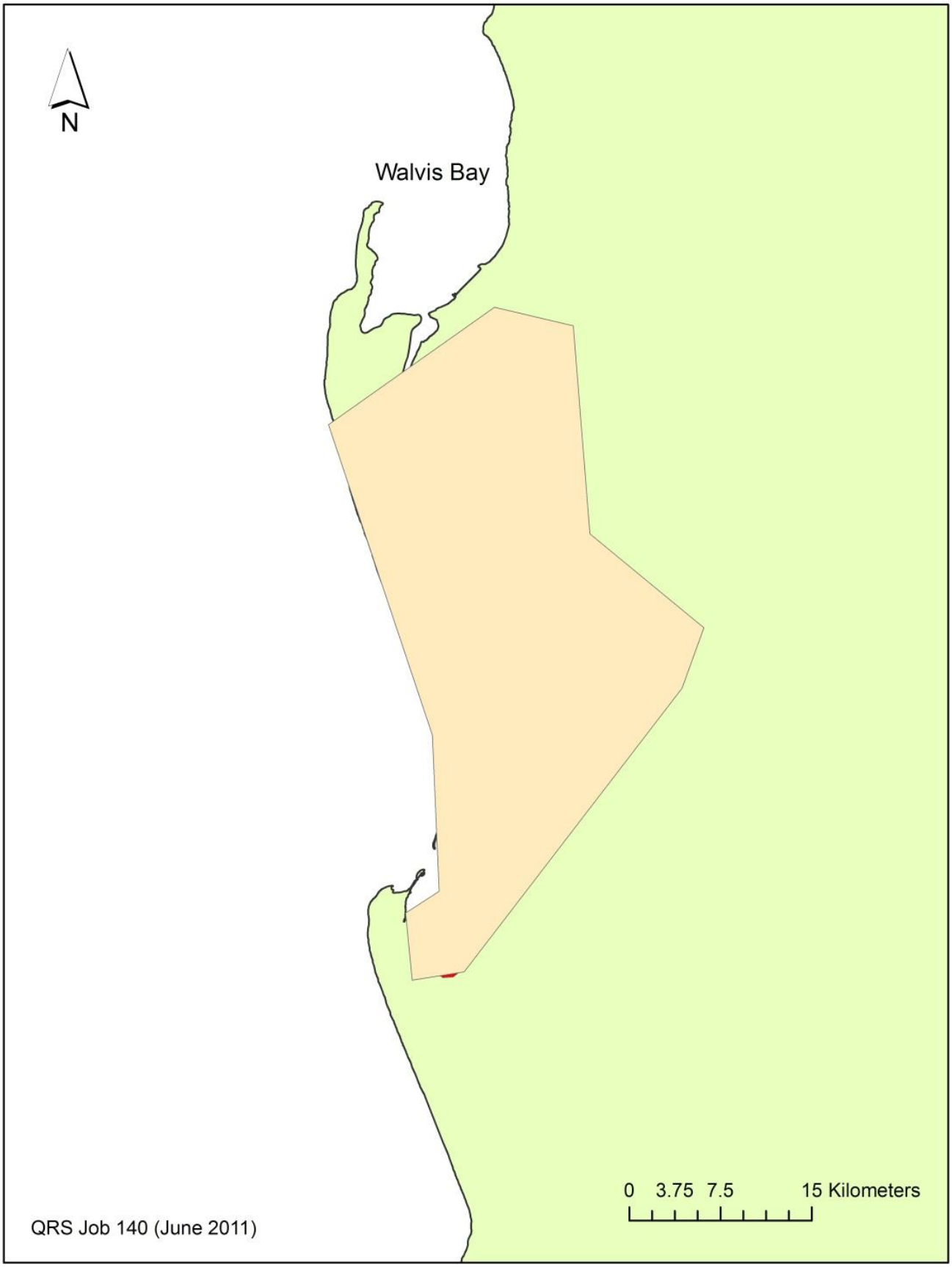


Figure 6.19: Proposed extent of the !Khuiseb Delta archaeological conservation area.

6.5 Ground Components

6.5.1 Geomorphological Setting

The Kuiseb Delta and Dune Belt areas are both located in the central Namib Desert ecoregion which extends along the coastal plain of western Namibia (Figs. 6.20). The Namib Desert extends inland from the Atlantic Coastline to the foot of the Namib Escarpment, a distance of between 80 and 200 km. The ecoregion can be divided into two areas: the Central Namib (from the Uniab to the Kuiseb Rivers) and the Southern Namib (from the Kuiseb River to the town of Lüderitz). In the north, the Central Namib merges with the Northern Namib or Kaokoveld Desert ecoregion and in the south it merges with the Succulent Karoo ecoregion, which extends up the west coast of South Africa. The natural environment and the climatic patterns of the Namib Desert vary considerably. A climatic transition belt crosses the coastline north of Walvis Bay, and divides the coastal area into a northern area receiving summer rainfall, considered the Kaokoveld Desert ecoregion and a southern area receiving winter rain (the Namib Desert ecoregion). The narrow strip of land within this transition belt (about 50 km) is the most arid area in southern Africa and receives sporadic, unpredictable rainfall without a clear seasonal pattern.

Locally, the Kuiseb Delta and Dune Belt areas are dominated by landforms of aeolian, denudation, fluvial-deltaic and marine (Fig. 6.20). As such, they inter-finger and form complex terrain units attributed to more than one geomorphological agents. By virtue of the geographic and climatic condition of the area, aeolian landform makes up the largest portion of the study area, constituting approximately 60%. Denudational landforms are distant second at 21% of the study area (Tables 6.14 and 6.15).

6.5.1.1 Terrain Units

Evaluation and assessment of the terrain units in terms of recreational activities (Fig. 6.20). Tables 6.14 and 6.15 reveals that two-third (67.03) of the study area has a high resilience to such anthropogenic activities, including quad-biking. Just over 15% of the study area is highly susceptible to such activities, however (Fig. 6.21). In the same vein, 13.04 % of the study area may be more resilient to some activities such as bird-watching, while more susceptible to other forms of recreation such as quad-biking. The remaining 5% of the study area falls under moderate to high resilience to recreational activities. Terrains units and their attributes are discussed below in details under the heading of main geomorphological processes, namely, aeolian, denudation, fluvio-deltaic and marine, that acted in their formation.

Table 6.14: Proportion of the study area with respect to resilience to recreational activities.

Resilience Ranking	Area (km2)	Proportion (%)
Low	112.4	15.02
Very Low to High	97.6	13.04
Moderate	23.66	3.16
Moderate to High	13.16	1.75
High	501.66	67.03
Total	**748.4**	**100.00**

Table 6.15: Area sizes and proportions of Terrain Units in the study area.

Origin	Terrain Unit	Perimeter (km)	Area (km)	Area (ha)	Area %
Aeolian	Barchan Dune	180.3	91.45	9145	12.2
	Transverse Dune	340.3	283.10	28310	37.9
	Complex Linear Dune	142.5	73.61	7361	9.9
	Dune Street	108.2	12.47	1247	1.7
				Sub-total	*61.7*
Fluvial	Pan	7.9	0.50	50	0.1
	Shallow Water Course	26.5	2.16	216	0.3
	River Bank	11.9	0.84	84	0.1
	River Valley	54.9	13.11	1311	1.8
				Sub-total	*2.2*
Fluvial-Aeolian	Abandoned Delta	18.3	9.45	945	1.3
	Abandoned Valley	34.4	7.66	766	1.0
				Sub-total	2.3
Fluvio-Deltaic and Marine	Estuary	99.6	87.08	8708	11.7
				Sub-total	*11.7*
Denudational	Sandy Plain	37.3	8.11	811	1.1
	Gravel Plain	363.7	103.62	10362	13.9
	Rocky Plain	51.9	52.69	5269	7.1
	Rock Outcrop	8.5	0.78	78	0.1
				Sub-total	22.1
Total		**1486.1**	**746.64**	**74664**	**100**

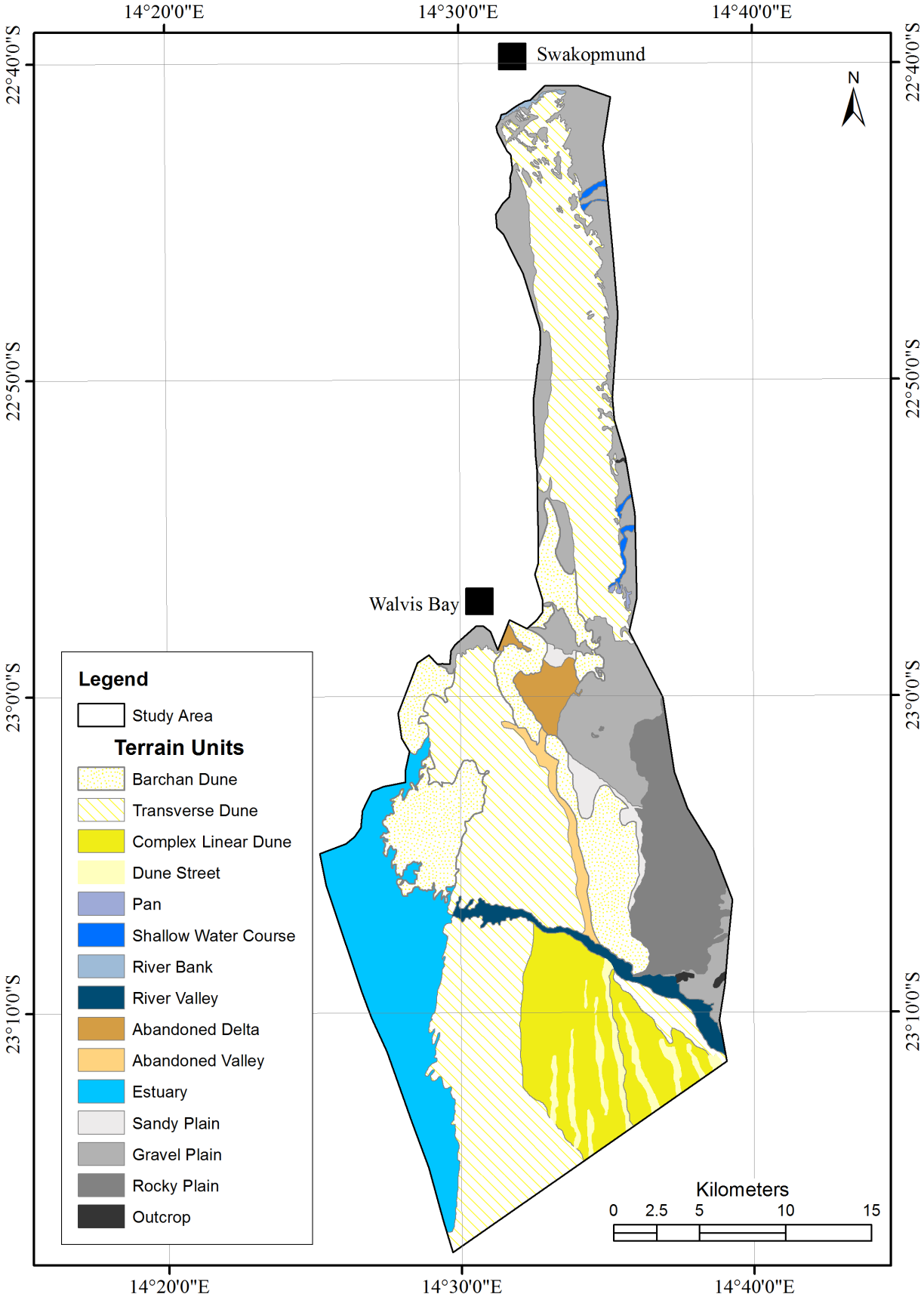


Figure 6.20: Geomorphic Terrain Units in the Study Area.

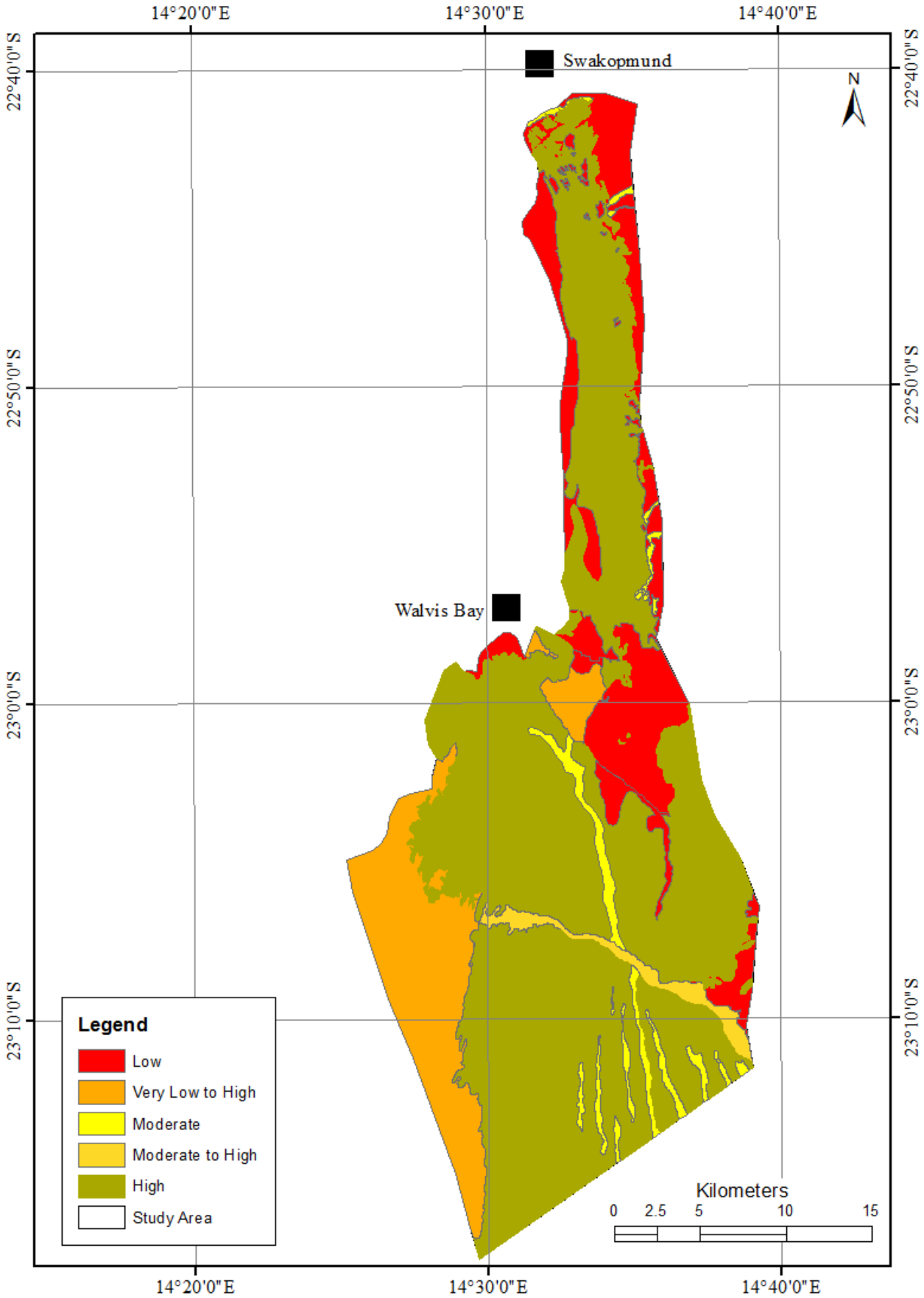


Figure 6.21: Resilience of Terrain Units to Recreational Activities.

6.5.1.2 Aeolian Landforms

By nature, deserts are characterized by sparse vegetation and low rainfall. For the Namib, under which the study area falls, the added cold-water upwelling system of the Benguela Current and the absence of convective cells, coupled with the availability of unconsolidated sediments contributed to that mix in favor of the predominance of aeolian landforms. These landforms are created by virtue of wind process through erosion and deposition.

From the coast, highly mobile **barchans** or **crescentic dunes** form. Barchan dunes develop on hard surfaces where the sand supply is limited, with prevailing dominant wind comes from a single direction (e.g. Thomas, 1989; Lancaster, 1995). These conditions fit areas such as the flat coastal plateau south of Walvis Bay and along the eastern side of the former northern extension of the Kuiseb River, where this feature occurs (Fig. 6.20). The dunes are white to beige in colour with an average height of 8.3 m and a range of 2 m and 20 m (Slaterry, 1990).

Based on 16 long profiles of these dunes south of Walvis Bay measured by Barnes (2001), the dunes present abnormal longitudinal profiles with no slip faces. Coarser materials are more significant on their crests. Using aerial photographs taken in 1961, 1976, 1988 and 1997, the same author noted that during the course of 38 year period a total of 58 distinct dunes studied moved northward as coherent bodies. She further documented that during intervening time interval of aerial photographs, rates of these dunes movement varied significantly. The highest recorded movement of these dunes took place between 1997 and 1999 with an average rate of 56.1 m per year. This rate was followed by a mean distance of 18.9 m per year that took place between 1961 and 1976, and 16.4 m/a from 1988-1997. The lowest recorded rate was 4.24 m per year which occurred between 1961-1976 (Barness, 2001).

Results outlined above followed the studies of Stengel (1963b) and Slattery (1990), both worked in the same area. Stengel (1963b) obtained an average rate of 23 m/a and 8 m/a for a 3 and 5.5 meter high dune, respectively. Using the first two sets of aerial photographs used later by Barnes (2001), Slattery (1990) calculated an average rate of 13.5 m/a for the movement of these dunes. This translates into a difference of three folds between the two researchers. Besides the apparent variance, what underlines the collective findings of these authors is that the movement of these dunes is not constant over the years. In that light, it is likely that a single storm with anomalously high velocity would cause rapid rates of dune movement over a short period of time as Barnes (2001) suggested. Under current and immediate future climatic regime, therefore, barchan dunes in the study area are expected to continue migrating northward at a rate in excess of 50 m per year for smaller dunes. Although barchan dunes are highly active from a geomorphic view point, they are more resilience to human activities such as quad-biking as human footprints could be easily erased from its surface by wind.

The rapid marching of individual barchan dunes is a finite process. Typically, wind speed tends to decrease with increasing distance from the coast, a pattern that was also observed in the Namib by Lancaster (1985), for example. According to Lancaster (1985) wind regimes in the Namib Sand Sea are high energy unimodal near the coast, and become bimodal or complex further inland. This is partly due to friction against the surface which effectively decreases the speed as well as the direction of the wind. In the process wind loses its initial strength for transporting sediments. The net result is that at some point, barchan dunes coalesce laterally with their neighbors to form **transverse dunes** (Thomas 1989; Lancaster 1985; Bourke & Goudie 2009). Thus, unlike barchan dunes, transverse dune forms under the environment with relatively ineffective wind and abundant sand supply. However, transverse dunes migrate as well, albeit slower, like their barchan prototypes (e.g. Thomas, 1989). Therefore, the study area is characterized by an overall decrease in wind energy and sand

transport rates from south to north and west to east, such that sand moves from coastal and southern source areas to accumulate in the northern and central parts.

Specifically, there is an ill-defined transition from barchan to transverse dunes in the study area. This takes place in the downwind of barchan fields, where individual dunes coalesces laterally into each other in the southern section of the study area. They thus run parallel to and on the eastern side of barchans fields as well as the Kuiseb Estuary. Moreover, the dune belt running along the coast between Walvis Bay and Swakopmund formed a contiguous body of transverse dunes. Dune 7, on the southern end of this dune belt is one of the renowned barchanoid ridges forming part of this transverse dune. Collectively, transverse dunes constitute the largest terrain unit in the study area, at 38% (Fig. 6.22).

Often characterized by a single slip-face, transverse dunes have a height estimated to range between a few meters up to 75 m in the southern part of the study area and over 130 m along the northern dune belt (Fig. 6.22). Because of their large sizes and the reduced wind velocities coupled with bimodal direction further inland, the rate of movement of these dunes is reported in the literature to much slower than barchan dunes. They are thus more stable on their base and with more mobility on crests. Engulfing of some of the palm trees planted more than 30 years ago at a picnic site at the heels of Dune 7 testify to the slow but steady northward marching of these dune bases.

Transverse dunes may further evolve into elongated dunes in areas with variable wind directions, like in some parts of the study area. Further west in the southern section of the study area, emerging **linear dunes** as well as **dune streets** are pronounced. These inception linear dunes have a width in excess of 1 km, while the width of the dune street measures up to 700 km. They form part of a much bigger body of sand sheet of the central Namib Desert to the south and east. Like the rest of the sand sheet, they are abruptly terminated by the Kuiseb River. Their heights are in tens of meters in the west and increases to more than 100 meters towards the east. Although linear dunes loose sands in the leeward, this process is compensated by sand arriving on the windward side, hence the moderate stability of this type of dunes and dune streets (Thomas 1989). This unit makes up approximately 10% of the study area. Similar to the barchan, both transverse and linear dunes are more resilience to tourists' related human activities. Dune street, however, are moderately resilient to recreational activities.

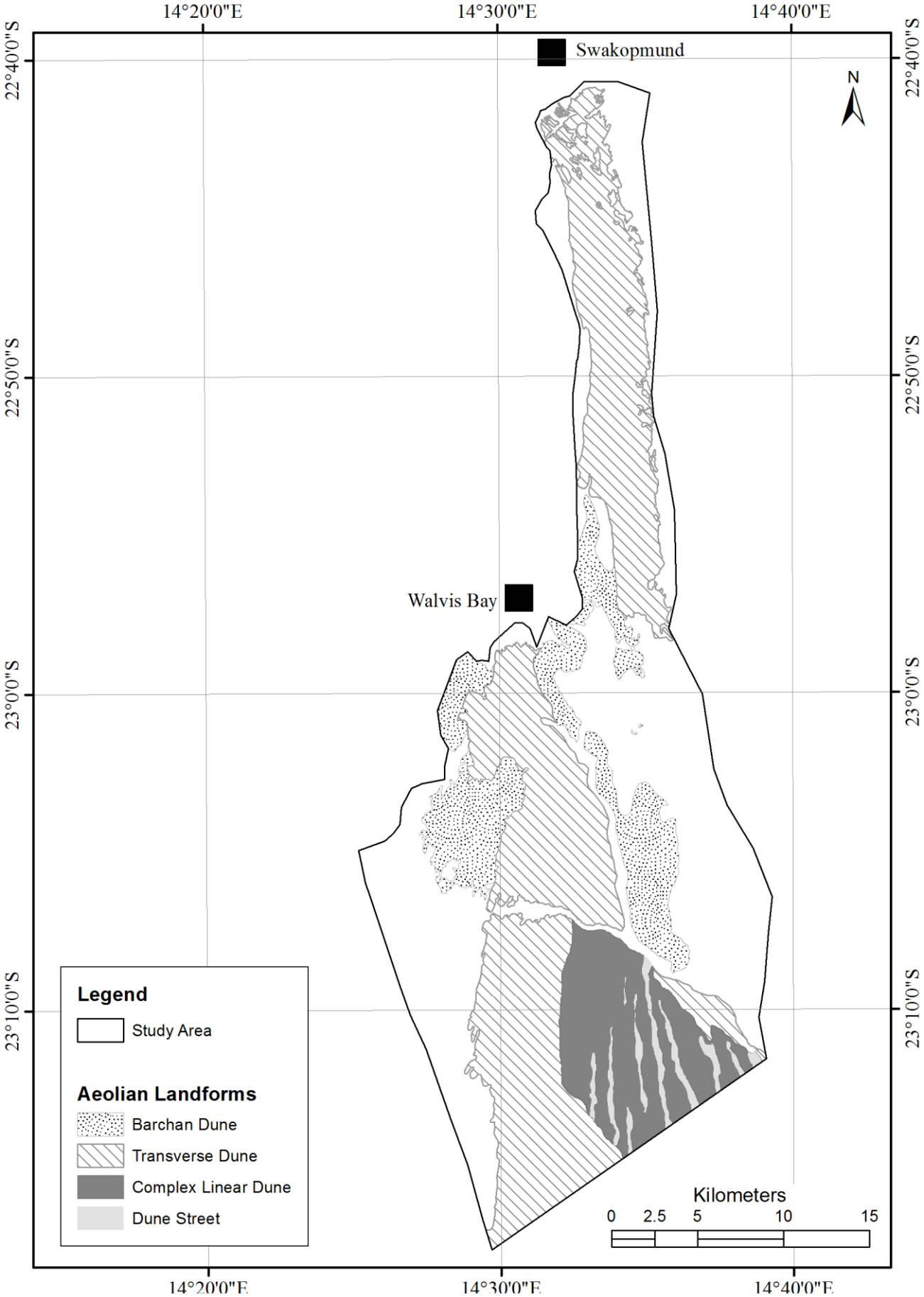


Figure 6.22: Terrain Units of Aeolian Origin.

6.5.1.3 Fluvial Landforms

Three sub-types of fluvial landforms feature in the study area (Fig. 6.23). The largest, at 1.7 % of the study area, is the conspicuous dry river beds of the **Kuiseb River**. This unit has a significant impact on the geomorphological character of the study area in that it provide sediments to the coast and also halts the northward movement of the Namib Sand Sea. In the study area, the Kuiseb River is up to 1 km wide with a gradient of 1:150 (Stengel, 1964b); the average gradient of the entire river is also relatively high, at 1:200. The south bank of the river consists of high sand dunes, while the north bank is partly rocky with high gravel terrace in places.

Although the current extent of the Kuiseb River testifies to its former glory as a perennial system in the recent past (geologically), it is currently an ephemeral river. In reconstructing its historical flow, Stengel (1964a) recorded that between 1837 and 1961, the Kuiseb reached the sea in 13 occasions, mainly through its northern tributary, which is now abandoned due to anthropological control. This amounts to an average of one flow every ten years. Since then, the river only reaches the sea in 1997, 2000 and 2011. In 2011, Namibia received exceptionally high rainfall resulting in some part of the country being flooded. During the fieldwork of this study in July 2011, the delta was not accessible by car as the area remained wet and roads leading to it were still closed off. Usage of a quad-bike, though penetrated the area, was eventually met with similar limitation. The geomorphic stability of this unit differs from place to place, depending of the morphometry, climatic regime and surface cover. It is thus categorized under moderate to high geomorphic stability and resilience to anthropogenic activities.

Other terrain unit of fluvial origin in the study area is the **shallow water courses** located on the eastern side of the dune belt area. They flow from the rocky plains of the Namib and terminate against the eastern side of the dune belt. At the southern section of the dune belt, water accumulates in few inter-connected **pans**. These units are geomorphologically moderately active. They are also not easily susceptible to human activities.

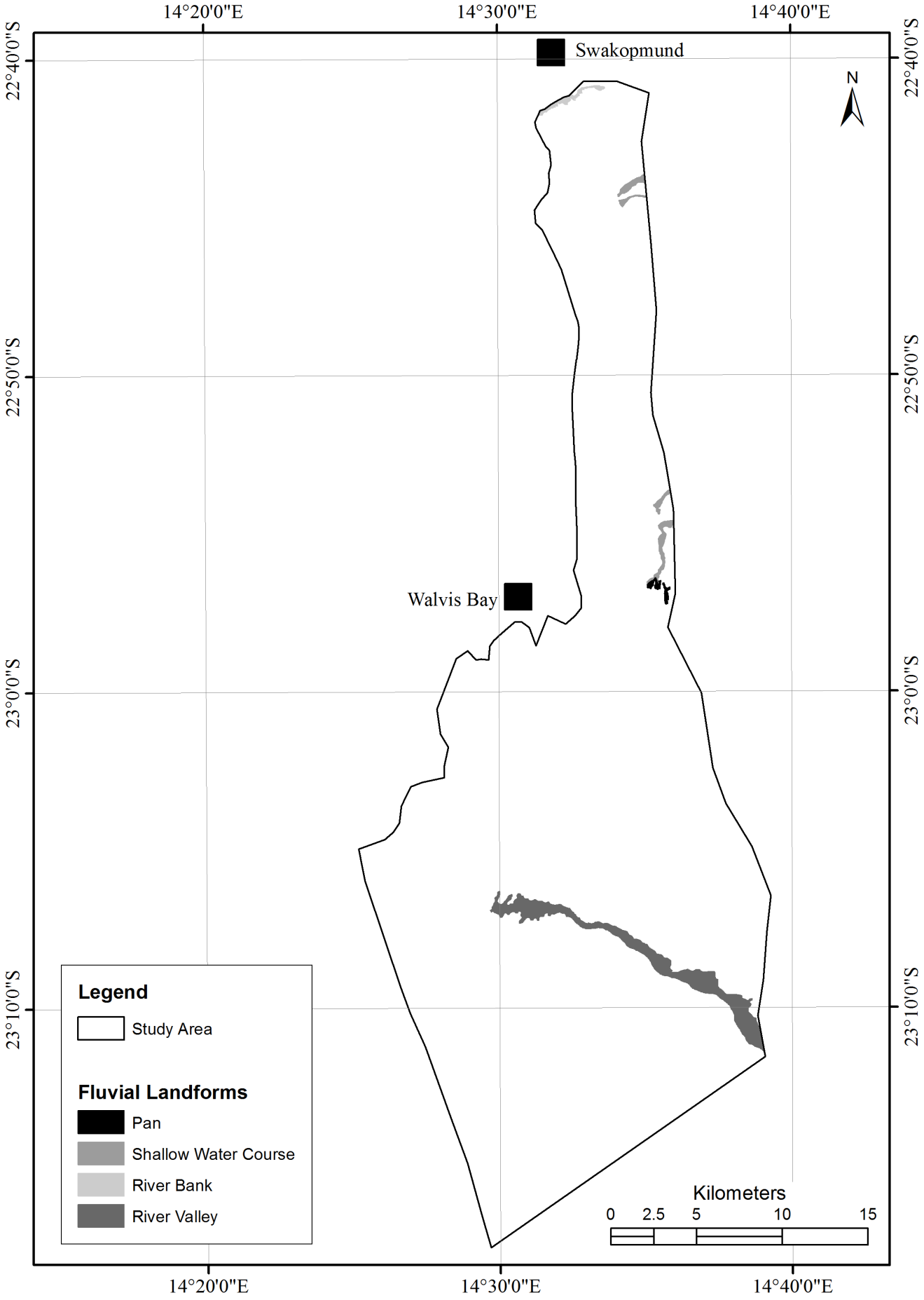


Figure 6.23: Fluvial landforms.

6.5.1.4 Fluvial-Aeolian Landforms

Geomorphologically, a major section of the City of Walvis Bay is situated in a delta. Until 1961, the town, with approximately 12165 inhabitants at the time, was occasionally inundated by high flood water of the Kuiseb River (Stengel 1963b), via its northern arm, branching off some 15 km before it reaches the sea, south of the lagoon. What changed that threat was a construction of a snaking wall 7.3 km long and 6 m high that separated the northern tributaries from the western one. Without water flushing out sediments in its bed as it used to be, these human activities turned the northern arm of the Kuiseb River and delta into abandoned features (Fig. 6.24), allowing dunes and drifts to accumulate over their beds.

The **abandoned valley** of the northern arm of the Kuiseb River and its former delta are discernible from satellite images. The valley lies between the transverse and barchans dunes in the west and east, respectively. The **abandoned delta** is surrounded and threatened by barchan dunes and part of its remnant is currently declared as a bird sanctuary. It is thus anticipated that with time, these former features of the Kuiseb River will be obliterated by aeolian sedimentation. Although the abandoned valley is moderately resilient to anthropogenic activities, the abandoned delta is highly susceptible to activities such as quad-biking and highly resilient to other activities such as bird watching.

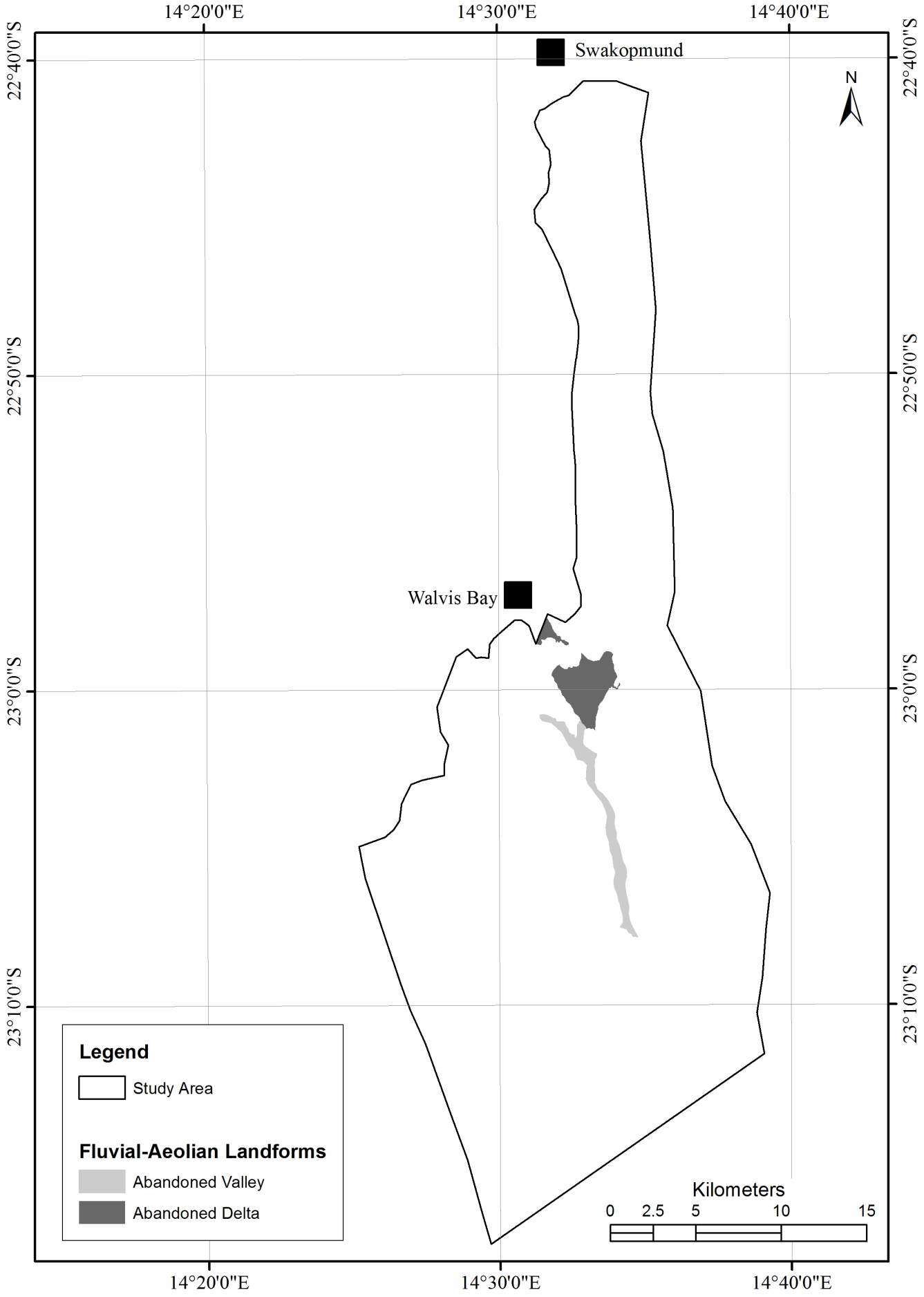


Figure 6.24: Fluvial - Aeolian Landforms.

6.5.1.5 Fluvio-Deltaic and Marine Landforms

By definition, estuary is a complex geomorphological unit forming a transition zone between freshwater rivers and salt-water oceans (Thomas & Goudie, 1985). It is further constantly modified by erosion and deposition by rivers and tidal currents, resulting into a host of various features such as tidal flats, salt marshes, delta, spits and lagoons. For the coastal Namib, wind as a notable geomorphological agent contributed to the presence of aeolian features in and around the estuary, hence the delineation of this feature including sand ridges (Fig. 6.25).

The **delta** is covered with extensive growth of *Phragmites* reeds. Hummocks forms in places around hardy bushes. With low dunes dotting the complex, channels of the delta itself are poorly defined. Similar to abandoned delta discussed above, this unit is rather sensitive to some human activities such as quad-biking, while highly resilience to others such as bird-watching.

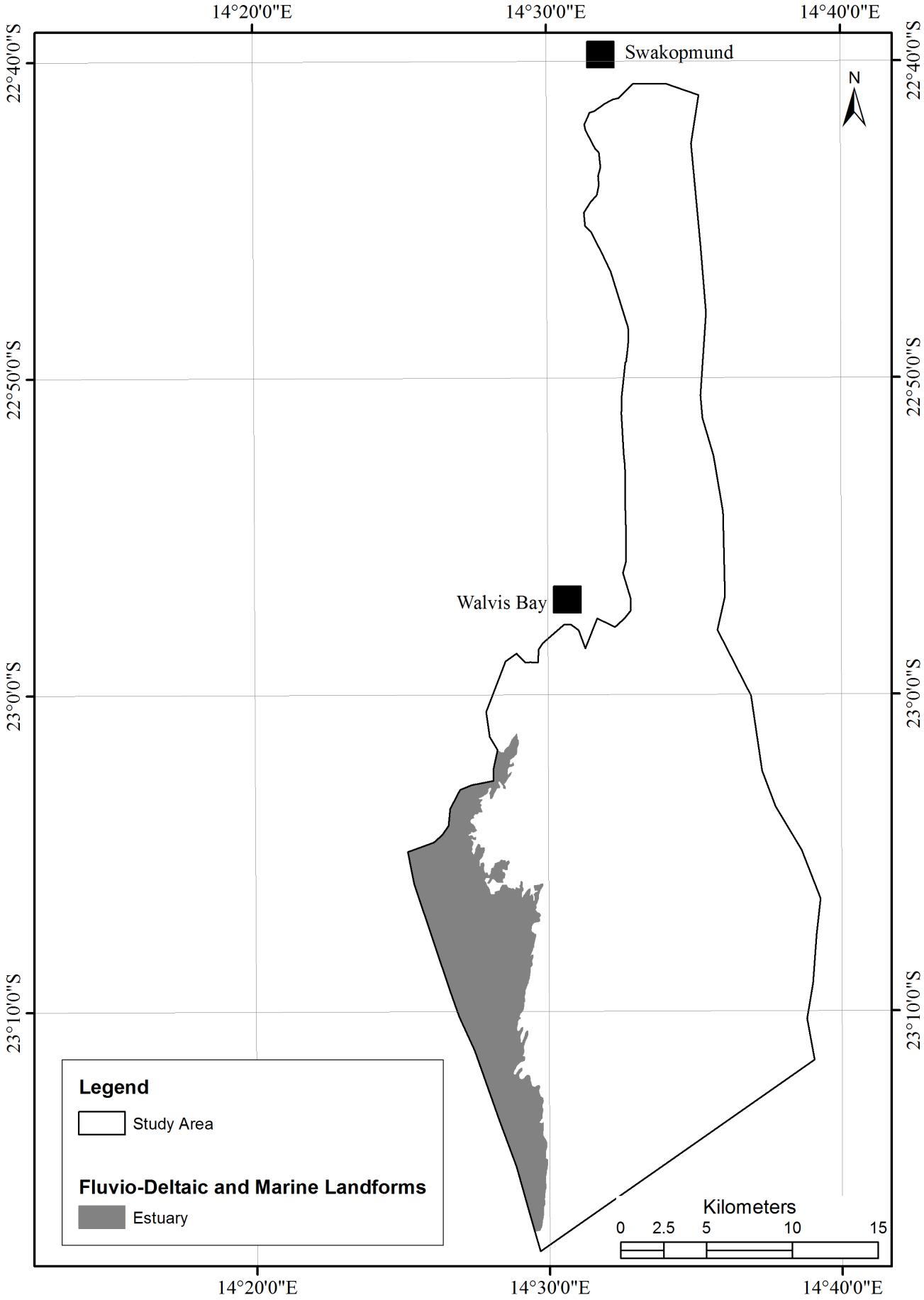


Figure 6.25: Fluvio-Deltaic and Marine landform.

6.5.1.6 Denudational Landforms

Landforms laying bare and exposing underlying rocks or strata owing to the removal of overlaying materials are classified as denudational. Besides erosion by agents such as water and wind, weathering is particularly incorporated into agents of denudation. The area located south-east of Walvis Bay in the study area falls in this category (Fig. 6.26). Besides water and wind erosions, weathering is also taking place in this area. This **rocky plain** is punctuated with rock outcrops, dominated by gneiss and granites. This unit makes up approximately 7% of the study area.

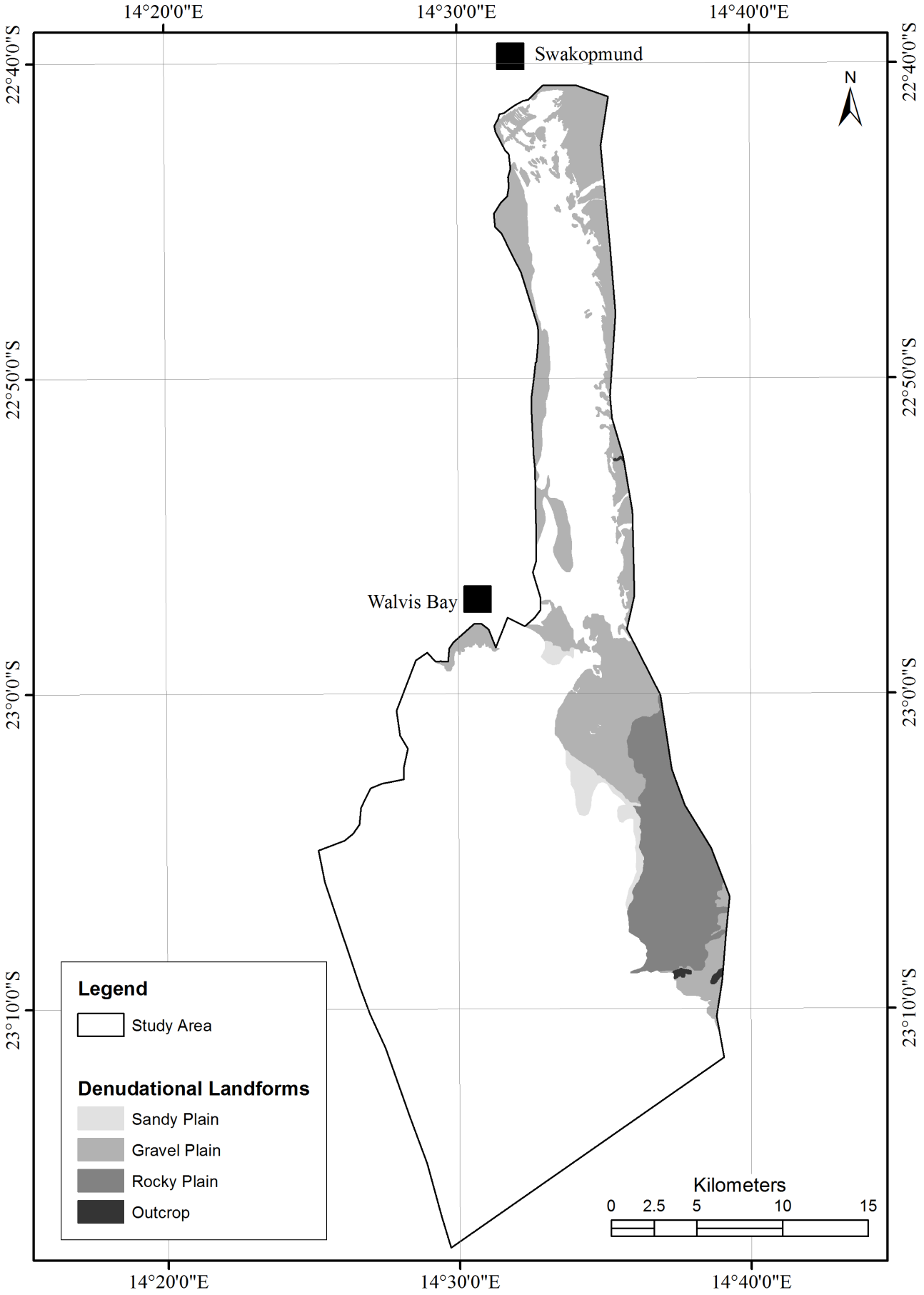


Figure 6.26: Denudational Landforms.

Similarly, **sandy and gravel plains,** totaling 15% of the study area, are common. Whereas sand plains dots the central part of the study area, broad gravel plains features on either side of the dune belt, while smaller ones with irregular shapes occur in the northern end and eastern side of the dune belt. It is hypothesized here that their density on the northern side of the dune belt is associated with the bidirectional wind pattern introduced by the east wind, essentially reversing dune sediments and promoting the presence of interdunal space around the more exposed area of the dune belt. Similarly, shallow river courses are attributed to the presence of the smaller, irregular gravel plains on the eastern side of the dune belt, in the same fashion as the area around Tsondabvlei and Sossusvlei. Whereas these denudational landforms are geomorphologically stable, sandy and gravel plains are rather sensitive to anthropogenic activities. Rocky plains and rock outcrops, however, may withstand a variety of recreational activities.

6.5.1.7 Conclusions

The study area is characterized by landscapes of aeolian, fluvial, denudational and fluvio-deltaic and marine origin. Aeolian landscape is the largest by far. A number of geomorphological units were also identified. From the south, the study area cut across the sand sea of the southern Namib. The eastern section of this area has complex linear dunes, oriented north-south, and approximately a kilometer apart. They grade into transverse dunes some 8 km from the coast and as the Kuiseb Delta begins to form. These dunes have their slip-face oriented mainly to the north, hence providing comparatively favourable climatic conditions for supporting selected desert dwelling fauna or flora and also sheltered from the strong winds blowing predominantly from the south.

Whereas transverse and barchans dunes cut across the Kuiseb Delta, longitudinal dunes came to a halt at the Kuiseb River. The Kuiseb Delta is up to approximately 15 km wide at the apex. It is characterized by a variety of vegetation, including reeds. This betrays a high water table. Dune hummocks occur in the immediate surroundings of the delta. Transverse and barchans dunes constitute the dune system between Walvis Bay and Swakopmund. Like the dune system south of the Kuiseb River, interdunal plains occur in places within this unit. A common feature in the interdune and gravel / coastal planes are patches of vegetated hummocks. A third of the study area is resilience to recreational activities, while 15% of this region is highly sensitive to such activities. Sensitivity of the remaining portion of the study area varies between moderate to high according to specific anthropogenic activities.

6.5.2 Geological Setting

6.5.2.1 Regional Geology

Regionally, Walvis Bay falls within the Central Zone of the Damara Sequence which underlies most of Central Namibia (Figs. 6.27 and 6.28). The oldest rocks within the Central Zone are the pre-Damaran basement that consists of gneiss and granite lithologies found in different parts of the zone (Fig. 6.28). According to Miller, (1983a), the Sequence was deposited during successive phases of rifting, spreading, subduction and continental collision. Much of the basal succession (Nosib Group), deposited in or marginal to intracontinental rifts, consists of quartzite, arkose, conglomerate, phyllite, calc-silicate, subordinate, limestone and evaporitic rocks. Local alkaline ignimbrites with associated subvolcanic intrusions ranging from 840 to 720 million years in age also form part of the regional geology (Miller, 1992).

According to Miller, (1992), widespread carbonate deposition followed and overlapped far beyond early rift shoulders (Kudis, Ugab and basal Khomas Subgroups); interbedded mica

and graphitic schist, quartzite (some ferruginous), massflow deposits, iron-formation and local within-plate basic lava point to fairly variable depositional conditions south of a stable platform where only carbonates with very minor clastics occur (Otavi Group). Near the southern margin of the orogen, deep-water fans, facies equivalents of the carbonates were deposited on either side of a Southern Zone ocean separating Kalahari and Congo Cratons (Auas and Tinkas Formations). Thick schistose metagreywacke and metapelite (Kuiseb Formation) overlie the above rocks.

6.5.2.2 Local Geology

Locally the Walvis Bay area is underlain mainly by biotite schists, quartzites, meta-greywackes, marbles and calc silicates of the Tinkas member of the Karibib Formation, Swakop Group of the Damara (Steven, 1993 and Table 6.16). These rocks have been intensely isoclinally folded and locally have a NNE/SSW strike. Dips are generally steep and Salem-type granites and pegmatites have intruded the area, mainly in the West. Karoo-age dolerite dykes intrude the Damara metasediments and trend parallel to the foliation. Surficial sediments of Tertiary to Recent age have been deposited over large parts of the whole of Walvis Bay area, mainly confined to present and paleodrainage features (Ransom, 1981). The calcareous grit is found around Walvis Bay area comprise relatively of mature sediment containing clasts largely consisting of rounded to subangular quartz and feldspar grains cemented by calcium carbonate. Clasts of Damara metasediments and Karoo dolerite are rarely present. The calcareous grit is preliminarily regarded as the oldest of the surficial sedimentary succession and fills an old paleodrainage feature through which the main present-day Tumas drainage cuts (Ransom, 1981; Bortom, and Ransoh, 1980; Bortom, 1977).

According to Ransom (1981), Bortom and Ransoh (1980) and Bortom, (1977), the other type of surficial deposits found in the Walvis Bay area in general, is the brown calcareous siltstone which is far more immature than the calcareous grit and contains more angular fragments and a higher percentage of mafic minerals. The cement is calcium carbonate and its brown colouration is due to the weathering of mafic minerals. Although it is considered to be younger it is often in direct contact with the basement schist due to overlapping on the edges of minor basins and paleochannels (Ransom, 1981). The youngest of the surficial sediments is the formation of gypsum which occurs as fibrous veins and as cement to the recent sands, river gravels, and sedimentary breccias. The gypsum appears to be forming at present as a result of the common sulphurous mists blowing off the sea and reacting with the calcareous sediments to form gypsum as a replacement of calcite.

Table 6.16: Damara stratigraphy of the Central Zone in the Usakos – Karibib – Omaruru Area (after Steven, 1993).

Group	Formation	Lithologies
Swakop	Kuiseb Onguati Karibib Oberwasser Okawayo Spes Bona Chuos Rossing	Metaturbidites and Biotite Schists and minor Calc-silicate Rocks and Marble Quartzite, Schist, Calc-silicate Rock, Marble Calcitic and Dolomitic Marble and minor Calc-silicate Rocks and Schist and minor Calc-silicate Rocks and Marble Daheim Member Continental Mafic Volcanics (only present in SCZ) Omusema Member Amphibolites (only present in SCZ) Biotite Schist, Calc-silicate Rocks and very minor Felsic Volcanics Calcitic Marble Biotite Schist, Calc-silicate Rocks and very minor Felsic Volcanics Glaciogenic Mixtite, Banded Iron Formation Dolomitic Marble, minor Calc-silicate Rocks and Calcitic Marble
Nosib	Khan Etusis	Pyribole Calc-silicate Rocks, minor Biotite Schist, Graphite Schist and Marble Feldspathic Quartzite, Grit and minor Calc-silicate Rocks and Schist

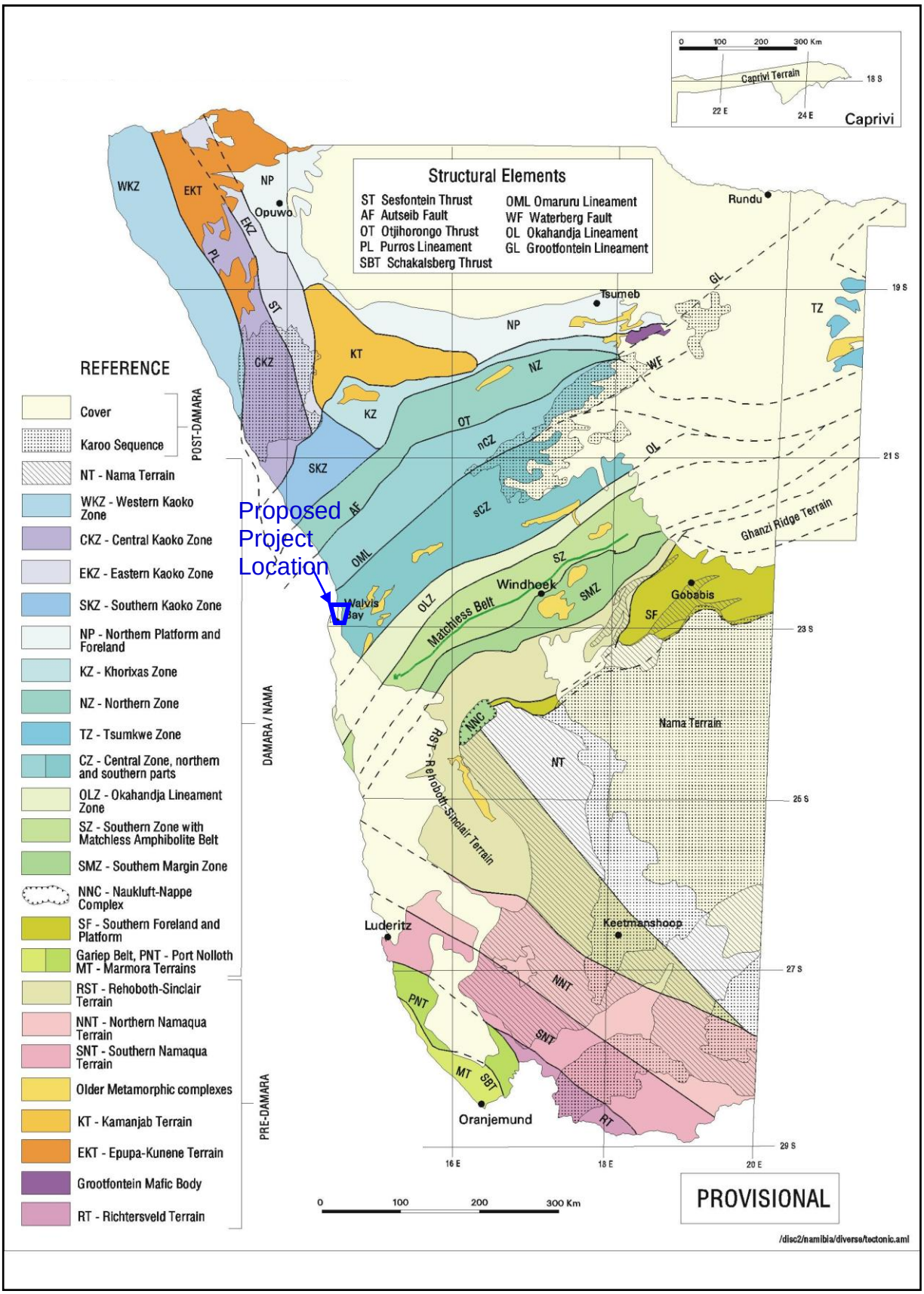


Figure 6.27: Simplified Tectonostratigraphic map of Namibia (Source: Geological Survey of Namibia, 1999).

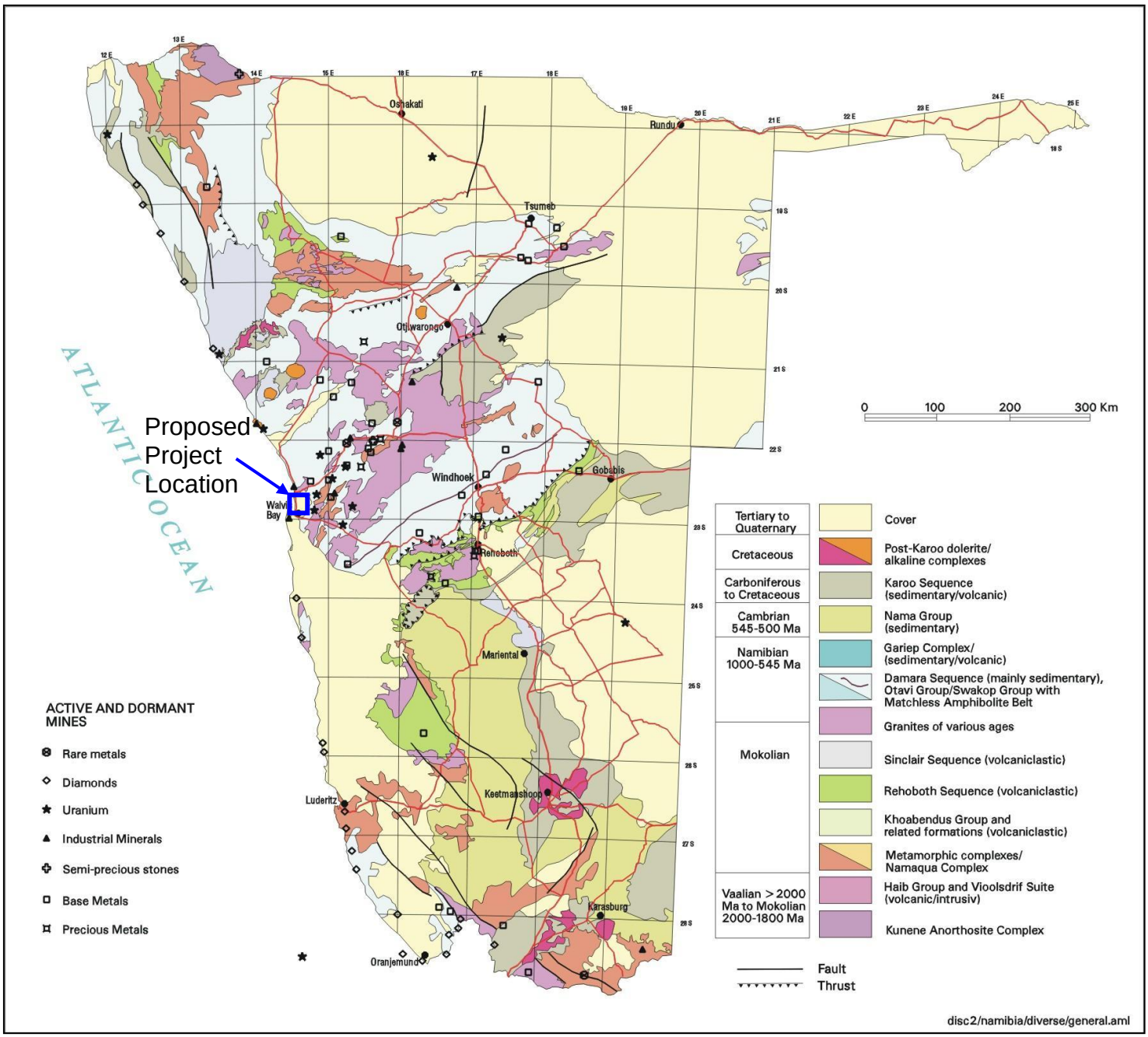


Figure 6.28: Regional geological setting of Namibia (Source: Geological Survey of Namibia, 1999).

6.5.3 Water

Namibia is the most arid country in Southern Africa. The mean annual rainfall is less than 50 mm per annum along the coast. Overall, water is therefore scarce and one of the most limiting factors to development. However, due to the good geological setting as well as good perennial river networks such as the Omaruru and the Kuiseb Rivers that extend into high rainfall catchments area, sufficient good quality groundwater is available in the coastal towns of Walvis Bay and Swakopmund as well as for the surrounding industrial mining activities in the Erongo Region.

The Erongo Region contains the urban demand centres of Walvis Bay, Swakopmund, Henties Bay, Arandis and the Rossing Uranium Mine which are currently supplied by abstraction of groundwater from the alluvium of the Kuiseb River in the south and the Omaruru River at Henties Bay in the north. Other Towns in the Region are Karibib, Usakos and Omaruru. Omaruru draws its water supply from boreholes in the Omaruru River, Karibib is linked by pipeline to the Swakopoort dam and draws water from this source, whilst Usakos relies on groundwater obtained from boreholes drilled into the alluvium of the Khan River for its water. Water is pumped from boreholes, transferred via pipelines and reticulated from reservoirs to individual consumers in the towns. Kuiseb River groundwater resources support the water demand of Walvis Bay, whilst water derived from the alluvium of the Omaruru River is pumped from Henties Bay to a central pump station at Swakopmund for distribution to Swakopmund, Arandis, and the Rossing Uranium Mine. The Namib Desert covers approximately half of the Erongo Region which is therefore largely arid. However both communal and commercial farming is conducted in the region supported by groundwater developed from discrete borehole sources. There are 330 rural water points in the Erongo Region.

The targeted proposed areas of the Kuiseb Delta and Dune Belt Areas hold good economic groundwater resources. However, some areas have saline shallow water bodies intruded from the seas.

Vulnerability assessment of surface water covered possible runoff, the presence of source factors and major flow routes such as ephemeral river channels, valleys and gullies as pathways and the presence of surface water body as a target. The groundwater assessments covered hydraulic properties and thickness of the unsaturated and saturated zones derived from geological and hydrogeological data. The assessment of the unsaturated characteristics was based on the ability for source factors to influence the system through known pathway factors such as the porous local sand aquifer of the Kuiseb Delta and Dune Belt areas. The combined effects of unsaturated and saturated flow probabilities were used as indicator for groundwater vulnerability. However, groundwater or surface water will only be vulnerable to contamination if there are contaminant sources, if there are pathways for contaminant migration and there are targets (surface water or groundwater) present.

Overall, the limited local groundwater resources found in the old Kuiseb River Channel form part of the unconfined aquifer system that is highly vulnerable to any sources of pollution. It is important that all polluting activities throughout the proposed projects life cycles must not be placed or undertaken in topographic low areas. Table 6.17 summarises the overall likely negative impacts associated with the proposed project with respect to water as well as other ground components.

Table 6.17: Overall assessment of the impacts associated with the ground components.

Description	The influences and impacts of the proposed projects activities on the ground components including geology, water and construction materials.
Extent	The extent of the likely negative impacts as a result of the proposed Kuiseb Delta and Dune Belt projects activities on the ground components will be localised and in particular will affect the immediate ground components particularly during the construction and operational stages.
Duration	The duration of the likely impacts will be permanent and beyond the duration of the proposed project.
Intensity	The level of impacts is likely to be moderate within the immediate environment and low in the surrounding areas.
Mitigation	1. Prevention, detection, and cleanup of released waste, cleanup equipment; the location and availability of suitable alternative equipment; and a plan of operations need to be put in place to be headed by the project manager; 2. All solid and liquid wastes generated as a result of the proposed project activities shall be reduced, reused, or recycled to the maximum extent practicable. Burial of waste on anywhere either on state or private property is not allowed and all waste must be disposed on approved Walvis Bay Municipal waste disposal site; 3. No littering in the site area including access roads must be always clean; 4. Oil cans, and all other forms of litter must be removed; 5. Trash may not be burned or buried, except at approved sites under controlled conditions in accordance with the regulations; 6. Disposal of wastewater into any public stream is prohibited;
Frequency of occurrence	The likely impacts are likely to occur during the construction period.
Probability	High = 1
Significance	Before for the negative impacts mitigation: **Medium to High** After mitigation: **Medium to Low**
Status of the impact	Negative
Legal requirements	Environmental Management Act, 2007, (Act No. 7 of 2007), Water Resources Management Act, 2004 and the Equator Principles.
Degree of confidence in predictions	The geological and geotechnical specialist who undertook the study and contribution to the above assessment is sure of the recommendations. Confidence level 80%.

7. IMPACTS, CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary of Likely Impacts

The impacts of tourism activities on the environment were evaluated in terms of nature of impact (identification), magnitude, extent, duration and significance as outlined in the Table 7.1. The impacts identified could be positive or negative. The overall likely impacts of the proposed construction, operation and development of tourism activities in the study area are outlined in Table 7.2. The assessment table also applies to identified and existing tourism operations in the study area.

Based on all the data collected and analysed at different stages of this EIA study process, including all the findings and recommendations of the specialist studies, all the results and recommendations have been evaluated and interpreted. Based on the extent, duration, intensity and likely negative and positive impacts of the proposed projects development for both the Kuiseb Delta and the Dune Belt areas, an Environmental Management Plan (EMP) Report Vol. 3 of 3 incorporating all the constraints, relevant mitigation measures with respect to likely impacts and recommendations has been prepared for implementation by the developer / operator. The EMP implementation and monitoring activities covers all the stages of the proposed projects life cycle and is inclusive of the preconstruction, development, construction and operational stages.

Table 7.1: Criteria used to evaluate impacts.

Criteria	Categories
Nature of Impact	Description of the effect of a proposed/existing activity on the environment. - Positive - Negative - Direct - Indirect - Cumulative - Synergistic
Magnitude	- Severe - Moderate - Low
Extent	- International - National - Regional - Local
Duration	- Short term - Long term - Project Life Span - Permanent
Significance	- High - Medium - Low

Table 7.2: Synthesis table of all potential impacts.

Description and Nature of Impact	Magnitude	Extent	Duration	Significance
Uncontrolled tourism and Unrestricted access NEGATIVE, DIRECT	Severe	Region & Local	The duration of the impact is expected to be short to medium term if mitigated	Before mitigation: **High** After mitigation: **Medium** to **Low**
Commercial activities and Urban development NEGATIVE, SYNERGISTIC	Severe	Local	Permanent if no mitigation	Before mitigation: **Medium** After mitigation: **Low**
National Park and Concession area's activities NEGATIVE, DIRECT AND SYNERGISTIC	Severe	Region & Local	Permanent to Long-term if not mitigated	Before mitigation: **High** After mitigation: **Medium** to **Low**
Placing of settlements, structures and facilities in highly sensitive archaeological areas NEGATIVE, DIRECT	Severe	Local	Permanent	Before mitigation: **High** After mitigation: **Medium** to **Low**
Faunal loss and disturbance NEGATIVE, CUMULATIVE	Severe to Moderate	Local	The duration of the impact is expected to be permanent over most of the proposed development sites once established. Most species (e.g. various birds and smaller mammals) are expected to re-colonise the area after completion of the development(s) – i.e. duration viewed as short to medium term – while other species are not expected to return (e.g. various secretive carnivores) – i.e. duration viewed as long term. This however, would be a relatively small area with localised implications.	Before mitigation: **High** After mitigation: **Medium** to **Low**
Floral loss and disturbance NEGATIVE, CUMULATIVE	Severe to Moderate	Local	The duration of the impact is expected to be permanent over most of the proposed development sites once established. Most species, especially annuals, are expected to re-colonise the area after completion of the development(s) – i.e. duration viewed as short to medium term – while the destruction of mature trees are not expected to rebound soon – i.e. duration viewed as long term. This however, would be a relatively small area with localised implications.	Before mitigation: **High** After mitigation: **Medium** to **Low**

Table 7.2: *Cont.*

Description and Nature of Impact	Magnitude	Extent	Duration	Significance
Sensitive areas in the Kuiseb and Dune Belt area NEGATIVE, CUMULATIVE	Biodiversity sensitive areas: **Severe** -Coastal area immediately north of Walvis Bay -Walvis Bay Lagoon -Kuiseb Delta -Sandwich Harbour **MODERATE to LOW** Inland Gravel Plains	International, Regional, National & Local	Permanent to long-term if not mitigated	Before mitigation: **High** After mitigation: **Medium** to **Low**
Socioeconomic POSITIVE, DIRECT AND INDIRECT	Severe	Local	Permanent to long-term	Before mitigation: **Medium to Low** After mitigation: **High**
Visual impacts NEGATIVE	Low	Local	Permanent	Before mitigation: **Medium** After mitigation: **Low**
Water use and quality NEGATIVE (unmitigated), POSITIVE (sustainable utilisation and management) DIRECT	Moderate	Local	The duration of this impact could last the entire project life span	Before mitigation: **Medium** After mitigation: **Low**
Waste and Sewage management at project sites POSITIVE (mitigation)	Moderate	Local	The duration of this impact could last the entire project life span	Before mitigation: **Medium** After mitigation: **Low**
Dune morphology and Wind situation NEGATIVE, INDIRECT	Moderate to low	Local	Short term and seasonal	Before mitigation: **High** After mitigation: **Medium to Low**
Cumulative Impacts NEGATIVE, CUMULATIVE	Severe to Moderate	National, Regional & Local	The cumulative impacts could last the entire project life span	Before mitigation: **Medium to high** After mitigation: **Low**

7.2 EIA Conclusions

The Environmental Impact Assessment study discovered that there are severe to moderate impacts on the natural environment as well as the cultural heritage of the area. The ongoing tourism activities and proposed community-based tourism activities in the Kuiseb Delta and Dune Belt Area might have negative direct and indirect impacts on the environment. The degree of confidence in predictions of these impacts is very high as specialists studies indicated. The potential threats identified in this study could be mitigated if conservation and preservation measures are adopted first before the implementation of the proposed development. The ongoing tourism activities continue to improve the socioeconomic status of entrepreneurs around Walvis Bay and Swakopmund area. Tourism ventures from other parts of the country also benefit from this area. The Kuiseb Delta Concession and project as well as the proposed bird watching paradise will significantly alleviate poverty and unemployment among Topnaars community along the Kuiseb Delta.

On the other hand however, the Kuiseb Delta project proposal is uninformed as to the archaeological value of the area and has used archaeological survey data merely as an aid to identifying the most commercially advantageous position for the project. The project is a community-based enterprise, but its formulation is no different from that of commercial tourism projects that fail to consider the potential impact of their activities. In this way, the Kuiseb Delta Development Project proposal represents a “worst case” scenario for the management and conservation of this archaeological landscape. The fact that it is supported by organizations such as NACOMA and evidently the Ministry of Environment, without the National Heritage Council demanding better controls, merely illustrates the institutional threats that are posed to the archaeological record in Namibia.

7.3 EIA Recommendations

This EIA study therefore recommends that the proposed projects and concession should not go ahead in its present form and must only be approved subject to the following suggestions:

- ✓ Proclaim the archaeologically significant part of the Kuiseb Delta as a Conservation Area under the National Heritage Act;
- ✓ Appropriate buffers must be created to separate current and future projects activities areas from key environmental sources such as the Kuiseb Delta archaeological sites, key avian breading zones of the Dune Belt Areas as well as other important habitats and conservation zones / corridors;
- ✓ Any access to archaeological sites should be strictly monitored and subject to specific guidelines as to routes, group numbers and other factors;
- ✓ No settlements, camping or other overnight facilities should be permitted in any area designated as archaeologically sensitive;
- ✓ Avoid all development in the areas viewed as sensitive habitats – i.e. Sandwich Harbour, lichen fields, Kuiseb and Tumas Rivers, rocky outcrops, Caution Reef, Horses Graves and Paaltjies *Salsola* dune hummocks;
- ✓ Implement and maintain track discipline limited to existing tracks and/or certain tracks with maximum speed limits (e.g. 30km/h) as this would result in fewer faunal road mortalities and associated dust pollution problems;

- ✓ Avoid off road driving in areas prone to scarring and especially the lichen fields. Nocturnal driving should also be avoided as this result in the destruction of slow moving fauna – e.g. various reptiles and other nocturnal species;

- ✓ Avoid the removal and damage of bigger trees (especially protected species – i.e. *Acacia erioloba*, *Faidherbia albida* and *Tamarix usneoides* [Forestry Ordinance No. 37 of 1952) – during developments – including the development of access routes – as these serve as habitat for a myriad of fauna. This is relevant to developments in the Kuiseb River area;

- ✓ The environmental management and monitoring of the dune belt area, the free off-road vehicle zone and the Kuiseb delta should form part of the Dorob National Park management.

It is hereby recommended that the proposed projects may only go ahead on condition that the proposed multiple land use approach (proposed and current activities, conservation and tourism opportunities) are all fully incorporated and integrated in the high need for archaeological resources conservation with appropriate buffers enforced in line with the specialist studies recommendations and in line with the Dorob National Park Regulations. In terms of the management of any likely short and long-term positive and negative impacts likely to be associated with the proposed developments for both the Kuiseb and Dune Belt areas, it's hereby recommended that an Environmental Management Plan Vol. 3 of 3 (EMP) Report must be developed for implementation by the proposed project developers for both the Kuiseb Delta and Dune Belt Areas covered in this EIA study.

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