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CHAPTER REVISION INFORMATION

Date Signed	Rev.	Remarks
April 2015	0	Sub-Revision 1: 18 July 2014 Included the comments received on 19 June 2014 from CoCT and CapeNature. Sub-Revision 2: August 2014 Included comments received from formal review from Eskom, CapeNature and CoCT. Sub-Revision 3: 20 April 2015 Included updates and comments received from the public review.

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2. DESCRIPTION OF THE KOEBERG NATURE RESERVE AND ITS CONTEXT

2.1 HISTORY AND PROCLAMATION STATUS

In the early 1970's, Eskom acquisitioned properties along the West Coast to build KNPS and with the option of further expanding the nuclear facility in the future. It has always been and still is Eskom's policy to ensure the management of the property in an environmentally sustainable and appropriate manner. Eskom strives to manage the site and the undeveloped areas surrounding the nuclear installation, in line with good environmental management principles and practices to the benefit of the environment and the people of South Africa.

Construction of KNPS in the dune field began in 1976 as shown in Figure 2-1. Unit 1 was synchronised to the grid on 4 April 1984, with Unit 2 following suit on 25 July 1985.

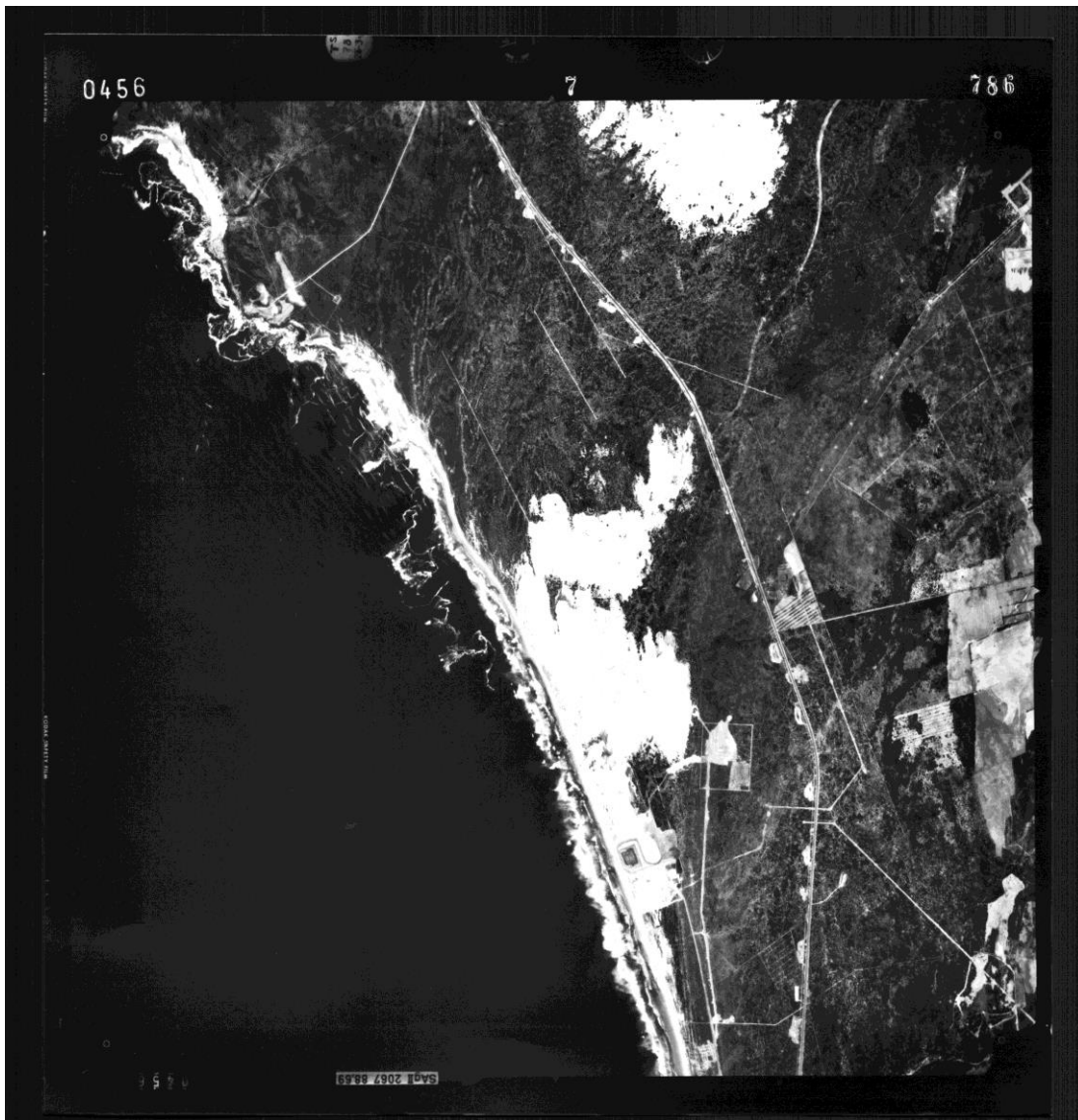


Figure 2-1 Aerial photograph of the KNPS during construction (late 1970's)

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On 12 July 1988, Eskom submitted an application in terms of section 12(4) of the Cape Provincial Nature and Environmental Conservation Ordinance 19 of 1974 to declare the Koeberg site as a private nature reserve.

In the application, Eskom raised the need for possible additional future nuclear development on the Koeberg site. The concern was raised that the land earmarked for development was included in the land proposed for the nature reserve and its sustainability was questioned. The authorities at the time responded that any development within the nature reserve is Eskom's prerogative and as such the land earmarked for development was included in the nature reserve.

While it is still Eskom's intent to keep the option open to develop the site for further nuclear plants it acknowledges that an Environmental Authorisation (EA) in terms of the National Environmental Management Act (1998) will be required prior to the commencement of the development. In addition it is anticipated that should an EA be granted for this development that the EA will indicate what administrative measures are required in terms of the NEM: Protected Areas Act (2003).

The "Koeberg Private Nature Reserve"¹ was proclaimed in 1991 in terms of the Ordinance 19 of 1974. The application, related correspondence and a copy of the gazette is attached in Appendix A.

The NEM: Protected Areas Act (2003) which came into effect after the proclamation of the nature reserve regards previously declared nature reserves as a protected area in terms of the new Act. One of the requirements of NEM: Protected Areas Act (2003) is the requirement to develop a management plan.

This Management Plan has therefore been developed to fulfil the legal requirements for the three properties proclaimed as the Koeberg Nature Reserve (first 3 properties in Table 2-1), and Eskom has included in the scope of the management plan two additional properties as they are collectively managed as part of the Nature Reserve (as shown in Table 2-1).

Table 2-1 Properties covered by in the Koeberg Nature Reserve Management Plan

Property Description	Hectares	Title Deed
Cape Farm 34 Duynfontein (southern property)	1 257,3890	T21209/67
Remainder of Portion 6 of Cape Farm 33 Kleine Springfontyn (northern property)	30,4260	T21287/78
Remainder of Cape Farm 33 Kleine Springfontyn (northern property)	1 399,4196	T13256/75
Portion 5 of Farm 2 Witzand	101,5741	T28036/95
Cape Farm 1 375	37,0639	T15352/80

In terms of condition 1.1 of the conditions imposed in terms of section 42(1) of the Land Use Planning Ordinance (LUPO) (Ordinance 15 of 1985) and Part I Section 7 of the Divisional Council of the Cape Zoning Scheme it is requires to consolidate Cape Farms 34 and 1 375. The consolidation of the two properties to Cape Farm

¹ Commonly known as the Koeberg Nature Reserve.

Duynefontyn 1 552 representing 1281,2844 ha, will be effective on the registry at the Deeds Office which has not happened as yet. Once this has been registered maps in the Management Plan will be updated at the next scheduled review as required.

2.2 LEGAL FRAMEWORK FOR THE NATURE RESERVE MANAGEMENT

There is a large body of legislation that is relevant to the management of the Koeberg Nature Reserve, but the primary legislation guiding the management of protected areas is NEM: Protected Areas Act (2003).

A list of known relevant legislation is provided in Appendix B.

2.2.1 Protected Areas in terms of the NEM: Protected Areas Act

The NEM: Protected Areas Act (2003) establishes the legal basis for the creation and administration of protected areas in South Africa, as its objectives include provisions “for the protection and conservation of ecologically viable areas representative of South Africa’s biological diversity and its natural landscapes”. The Act sets out the mechanisms for the declaration of protected areas and the requirements for their management.

In the Western Cape, CapeNature is the Provincial Conservation Authority and its Stewardship Programme enables the establishment and facilitation of the management of protected areas in the Province.

2.2.2 Invasive Species Control in terms of NEM: Biodiversity Act

In terms of section 76 of the NEM: Biodiversity Act (2004), the management authority of a protected area must incorporate an invasive species control plan in the protected area management plan. This is addressed in Section 2.4.8.

2.2.3 Provincial and Municipal Level Planning

In addition to national legislation, some of South Africa's provinces have their own provincial biodiversity legislation, as nature conservation is a concurrent function of national and provincial government in terms of the Constitution (1996).

The Provincial Department responsible for environmental matters is the Western Cape Department of Environmental Affairs and Development (DEADP) Region B2. Relevant provincial legislation includes, but is not limited to:

- Cape Provincial Nature and Environmental Conservation Ordinance 19 of 1974;
- Land Use Planning Ordinance, 1985 (Ordinance 15 of 1985); and
- Western Cape’s Provincial Spatial Development Framework.

The Municipal Department responsible for environmental matters in the West Coast Regions is the CoCT: Environmental Resource Management (Blaauwberg District). Relevant municipal legislation includes, but is not limited to:

- City of Cape Town’s Invasive Alien Species Strategy (2008);
- City of Cape Town’s biodiversity network (BioNet);
- City of Cape Town’s Air Quality By-Law (2010);
- City of Cape Town Special Development Framework (2012); and
- City of Cape Town: Blaauwberg District Plan: Spatial Development Plan and Environmental Management Framework (2012).

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2.3 THE REGIONAL AND LOCAL PLANNING CONTEXT OF THE KOEBERG NATURE RESERVE

2.3.1 EIA Regulations in terms of NEMA and LUPO

The following Environmental Authorisations (EA) in terms of the National Environmental Management Act (NEMA) (Act 107 of 1998) and the Environmental Impact Assessment (EIA) Amendment Regulations (2006), and rezoning certificates in terms of the LUPO (Ordinance 15 of 1985) have been obtained by Eskom for developments within the Koeberg Nature Reserve:

Table 2-2 Environmental Authorisation and Rezoning Approvals for development within the Koeberg Nature Reserve

Authorisation	Description	Dated	Reference Number
EA	Construction of the Koeberg Administrative Complex and Training Centre Campus located on Cape Farm 34, Duynefontein	2009-02-20	12/12/20/997
Rezoning	Rezoning and Conditional Use of Cape Farms 34 and 1 375	2010-10-29	LC CFM 34 & 1375 Application No: 167489
Appeal Decision against EA (above)	Construction of the Koeberg Administrative Complex and Training Centre Campus located on Cape Farm 34, Duynefontein	2010-11-23	12/12/20/997
Rezoning	Rezoning and Conditional Use of a Portion of Cape Farm 34	2011-06-13	LC CFM 34
EA	Construction of the 132 kV Overhead Power line from the Dassenberg Substation to the KNPS	2013-03-28	NEAS: DEA/EIA/0000723/2011 DEA: 14/12/16/3/3/11/329

The following conditions have been highlighted as specific to the Nature Reserve:

- The consolidation of the two properties (Cape Farms 34 and 1 375);
- The development of a Site Development Plan (SDP) for the Cape Farms 34 and 1 375, Duynefontein;
- Minimum of 10 m wide buffer area between the foot of the vegetative dune located on the western edge of the proposed training centre/canteen and the proposed training centre/canteen itself;
- Minimum of 30 m buffer between the wetlands identified as Sw3, Sw6, and P1 (Figure 2-2);
- Eskom to submit a management plan for the Koeberg Private Nature Reserve for approval to CapeNature. Eskom is also required to enter into a stewardship agreement with CapeNature;
- The management of vegetation under power lines and servitudes must be undertaken in accordance with the Vegetation Management Plan dated February 2013; and

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- Rehabilitate the quarry.

A transmission corridor vegetation management plan was specifically developed to address the construction and operation of the proposed 132 kV overhead power-line from Dassenberg Substation to the KNPS. This management plan concluded the activities required by the KMA in terms of the following:

- removal of alien vegetation,
- rehabilitation on disturbed areas,
- not using herbicides on natural vegetation and restricting the application of herbicides to alien vegetation,
- the recommendations in terms of specie specific pruning, and
- training and monitoring activities.

Where applicable, the application of these activities will also be expanded to all transmission line corridors within the Nature Reserve.

2.4 ECOLOGICAL CONTEXT OF THE KOEBERG NATURE RESERVE

The ecological footprint as listed in Table 2-1, excluding the operational footprint, i.e. the KNPS and its associated infrastructure, is being discussed and managed under this Nature Reserve Management Plan.

Section 5 provides more detail on the management of the ecological footprint, which has been zoned as Conservation Area and its Special Management Overlays.

A land management agreement is in place between the Eskom Real Estate (ERE) and the Koeberg Operating Unit (KOU), whereby the ERE will manage all Eskom land on behalf of the KOU.

2.4.1 Climate and Weather

The area has a temperate, Mediterranean-type climate with about 75% of the annual rainfall occurring in the winter months between April and September. Rainfall is cyclonic due to cold fronts moving in from the South Atlantic Ocean. The cold Benguela current inhibits cloud development and the area receives an annual rainfall of 372,5 mm.

Summers are hot and dry with an average temperature of 28°C between January and March. Winter months are cold and wet with an average temperature of 17°C during July. Wind which is a characteristic feature of the West Coast can often be very strong.

Fog is a regular occurrence along the West Coast during the summer months and can drift as far as 3 km inland. The moisture supplied by the fog compensates for the relatively poor rainfall during the summer months.

2.4.2 Topography

The Nature Reserve is located in the southwestern portion of the Western Cape Province, on the West Coast approximately 25 km north of Cape Town, the largest nearby metropolitan area and falls within the Cape Town District Municipality.

The site is bounded to the west by the Atlantic Ocean. The sandy shoreline is oriented northwest-southeast and comprises a wave-cut platform. The landform inland for a distance of up to 10 km is comprised of a dune field which is mainly vegetated.

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The highest point of the dune field is approximately 6 km from the coastline and has an elevation of 124.4 m. The coastal plain undulates between approximately 20 to 60 m above mean sea level (m amsl) with a terrace approximately 20 m above the mainly sandy shore.

The Nature Reserve adjoins the Duynfontein residential area to the south and is 8 km southwest of Atlantis (distances measured from the site centroid to nearest town boundary). The R27 (West Coast Road), runs in a north-south to northwest direction on the eastern boundary of the site boundary. A tarred access road leads from the R27 to the existing Koeberg Nuclear Power Station (KNPS) and an alternative access route is via the Duynfontein residential area to the south.

The Nature Reserve is predominantly covered by tall shrubland (Strandveld), fynbos and sand dunes. The 5 to 10 km band reflects the first significant agricultural activity, with wheat, fodder crops and dairy farming being predominantly and these land uses continue to dominate to the north and east of the site.

There are no rivers in the nature reserve itself but there are ecologically important wetlands present to the north and south of the KNPS.

2.4.3 Geology and Soil

The bedrock underlying the Duynfontein site consists of the Tygerberg formation and belongs to the Malmesbury Group, which is the oldest rock in the Boland. The soils consist of unconsolidated sand, which are underlain by calcrete and limestone. A large area of the site is covered by driftsand that does not support vegetation. Light grey to pale-red sand occur in the area with a low agricultural value and together with the unconsolidated sand it supports Strandveld and Coastal fynbos (Marshall & Mommsen, 1994).

The site and surrounding area are underlain by rocks of the Malmesbury Group, with outcrops along the coast. The Malmesbury Group is overlain by varying thicknesses of Cenozoic-age, mostly unconsolidated sediments, primarily of the Sandveld Group, which is itself overlain by narrow strips of alluvium along the river channels mentioned above and/or soil.

The Malmesbury Group is comprised of metasediments belonging to the Tygerberg Formation. This formation consists mainly of interbedded greyish, fine to medium grained greywacke, phyllitic shale, siltstone and impure quartzite with minor impure limestone and tuff beds. These rocks are baked to a massive bluish-grey hornfels along the contact zone with the intrusive Cape Granite Suite (not outcropping on the site) and along narrow dolerite dykes.

The Malmesbury Group underlying the site comprises a steeply dipping (up to 60°), interbedded, laminated succession of greywacke, siltstone and mudstone, with occasional shale beds². Gradational successions and contacts are characteristic and the beds are upward-fining. These rocks are highly weathered within the upper 10 m, with an average of 3.7 m of residual clayey silt being observed during previous³ and new Site Safety Report drilling at the site. The bedrock shows near upright to southwest verging folds and is intensely jointed resulting in a slaty-cleavage. It is brecciated along fault zones, and is often sheared along such fault

² Source: Johnson, MR; Anhaeusser, CR and Thomas, R.J. (eds.) (2006), The Geology of South Africa. Published jointly by the Geological Society of South Africa (Johannesburg) and the Council for Geoscience, Pretoria.

³ Source: Koeberg Site Safety Report. Chapter 9: Hydrology. (Rev 3), Johannesburg. Eskom 2006.

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planes. Northwesterly trending faults and dykes are visible in the bedrock to the east and northeast of the site but these faults do not appear extensive. Traces of dykes (dolerite, granodiorite or quartz porphyry) occur in the northern part of the site with a dominantly northwest trend.

The Sandveld Group comprises six formations of fluvial, estuarine, shallow-marine and aeolian sediments of Cenozoic (Miocene to Late Pleistocene) age⁴. The thickness of the various formations of the group varies considerably and reaches a maximum thickness of between 40 and 70 m, at Witzand. The various formations and lithologies are listed in Table 2-3.

⁴ Source: 5.11.17 Geological Survey (1984), The Geology of Cape Town and Environs: Explanation of 1:50 000 Sheets 3318 CD and DC and 3418 AB, AD and BA. Pretoria.

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Table 2-3 Lithostratigraphy: Sandveld Group

Formation	Member	Origin	Type	Description	Epoch
Witzand		Aeolian	Sand	Fine- to medium-grained, whitish grey to slightly reddish, calcareous, cross-stratified, partly vegetated mobile calcareous dune sands containing snails, echinoid spicules, forams and comminuted sea shells	Holocene 0.01 to 0 Ma
Springfontyn		Aeolian	Sand	Fine- to medium-grained, reddish to grey quartz, muddy and peaty in places	Pleistocene to Holocene 1.8 to 0.01 Ma
Langebaan		Aeolian	Calcareous and sandstone	Cross-bedded, fine- to medium-grained, with calcrete layers	Late Pliocene to Late Pleistocene 2 to 0.2 Ma
Velddrif		Shallow marine	Gravel and sand	Partially consolidated, shelly and pebbly, cross-bedding	Pleistocene to Late Pleistocene 1.8 to 0.2 Ma
Varswater	Muishond Fontein	Estuarine/ shallow-marine	Sand	Phosphatic, quartz-sand	Miocene to Pliocene 23 to 5 Ma
	Langeberg	Estuarine/ shallow-marine	Sand	Non-phosphatic, carbonaceous clay and lignite lenses	Miocene to Pliocene 23 to 5 Ma
	Konings Vlei	Shallow-marine	Gravel	Pebbles and cobbles	Miocene to Pliocene 23 to 5 Ma
	Langeenheid	Estuarine	Sand	Argillaceous (clayey sand/silt)	Middle Miocene 14 Ma
Elandsfontyn		Fluvial	Sand and gravel	Angular clasts, Carbonaceous, clay and lignite lenses	Early to Middle Miocene 23 to 14 Ma

2.4.4 Dune Systems⁵

The dunefield within the Nature Reserve forms part of the Atlantis corridor dunefield. The Atlantis corridor dunefield formed during the Holocene (the last 6500 years). The dunefield is mostly naturally vegetated, consisting of parabolic dunes. The patches of mobile transverse dunes are naturally unvegetated. The transverse dunes move northward, driven by the dominant southerly wind. This is probably the southeast wind of the Cape Town area, which swings to a direction varying from south to southeast up the west coast. The alternation of vegetated and unvegetated dunes is due to sand being supplied to the dunefield in pulses. The patches of mobile transverse sand dunes have been artificially vegetated in places, mostly in the southern end. Duynfontein lies at the southern end of this dunefield. The dunefield at Duynfontein consists of four dune varieties:

- Currently active transverse dunes
- Artificially stabilised transverse dunes

⁵ Source: Environmental Impact Assessment for the Proposed Nuclear Power Station ('Nuclear-1') and Associated Infrastructure – Dune Geomorphology Impact Assessment. Illenberger & Associates, October 2010.

- Mid Holocene parabolic dunes
- Late Holocene parabolic dunes

The Mid and Late Holocene dates are not accurate. They are based on their geomorphologic character, and are sufficiently accurate to illustrate dune processes. At the northern end of the Atlantis corridor dunefield there are Early Holocene parabolic dunes.

The currently active or mobile transverse dunes are on average about 8 m high, with the highest dunes reaching 12 m. The parabolic dunes are on average about 5 m high. Movement rates have not been calculated in this area, but are estimated to be about 5 to 8 m/yr. The average rate of sand movement is estimated to be about 20 m³/m width/year.

Groundwater only “daylights” in one or two small ephemeral interdune hollows within the Nature Reserve (Day, 2009). The dune dynamics are thus very unlikely to have any significant interaction with wetlands or groundwater.

The sensitivities of the dunefield types are:

- Currently active transverse dunes are resilient because the wind will re-create their natural shape if they are disturbed artificially (Rust & Illenberger, 1996). This type of dune is thus classified as having a low sensitivity.
- Artificially vegetated transgressive dunefields have a low sensitivity as soil is very poorly developed on these dunefields, with very few nutrient-rich fines. Any winnowing out of fines if the dune sand is de-vegetated during construction will thus have a very low impact as very few nutrients will be lost. Further, any disturbed or damaged vegetation can be rehabilitated by replanting the dune sand with suitable pioneer species of indigenous vegetation to re-stabilise the dune sand.
- Mid and Late Holocene parabolic dunes that are naturally vegetated have a low sensitivity as soil is very poorly developed on Holocene dunefields, with few nutrient-rich fines. Any winnowing out of fines if the dune sand is de-vegetated during construction will thus have a low impact as few nutrients will be lost. Further, any disturbance or damage to the vegetation can be rehabilitated by replanting the dune sand with suitable pioneer species of indigenous vegetation to re-stabilise the dune sand.

2.4.5 Hydrology

2.4.5.1 Wetland Ecosystems⁶

No rivers flow through Nature Reserve and the closest drainage line of significance is the Sout River and its largest tributary, the Donkergatspruit. The Sout River enters the sea at Melkbosstrand, south of the Koeberg Nature Reserve.

The south-western portion of the nature reserve, south of the KNPS, is the only part of the site where the terrain is sufficiently low-lying to support significant areas of wetland habitat. These wetland systems are separated from the coast by a line of low dunes, and comprise an extensive mosaic of seasonal wetlands that are fed primarily by groundwater. A few other seasonal wetlands occur in isolated areas to

⁶ Source: Environmental Impact Assessment for the Proposed Nuclear Power Station (‘Nuclear-1’) and Associated Infrastructure: Wetland Ecosystems. Johannesburg, Eskom (2009).

the north and east of the wetlands described above (see Figure 2-2), but with the exception of one wetland (Sw7 - described below). No wetland habitats are in the mobile dune areas.

All of the wetlands identified within the nature reserve are classified in terms of the National Wetland Classification System as 'wetland depressions', which occur within a largely flat landscape, indicative of a plain landscape setting. In the past, a large proportion of the seasonal wetlands on the site were heavily invaded by woody alien plants. Clearing of this vegetation approximately 10 years ago has resulted in the overall recovery of wetland habitats within these areas.

The two categories of depressional wetlands are described below and mapped in Figure 2-2.

2.4.5.1.1 Seasonal wetlands (Sw)⁷⁸

These are mostly located in the south-western portion of the site, where they are separated from the coast by a line of low dunes, and collectively comprise an extensive mosaic of seasonally inundated duneslack wetland. Two bands of this mosaic wetland can be distinguished, along with a number of more isolated depressions, viz:

- Sw1 - the wetland flats immediately adjacent to the coast, which have probably been flattened to some extent by an access road along their edge;
- Sw2 - a series of shallow, seasonally inundated depressions east of a low-lying dune ridge - Inundated portions of the depression are edged by reedbed or seasonally saturated wetland vegetation, with, in places, small terrestrial hillocks and shallow ridges separating the wetland units⁹;
- Sw3, Sw5, Sw6 and Sw7 - isolated seasonally saturated or inundated depressional wetlands to the north and east Sw1 and Sw2, as well as on the dunefields in the north of the site.

The seasonal wetland depressions are fed primarily by a seasonally fluctuating water table, which forms surface pools of shallow, fresh to brackish water during winter. The pools provide breeding habitat for frogs as well as numerous aquatic and semi-aquatic invertebrates. The pools dry out in summer as the water table recedes.

With respect to aquatic invertebrate fauna, the site wetlands form part of a clearly defined group of wetlands from the West Coast region of the Western Cape. The species composition of this grouping can be differentiated from other geographical areas in the region by the predominance of micro-crustacean taxa – a group that characterises many seasonally inundated wetlands and, in the Western Cape, may include a number of regional or even local endemics (mainly from the Classes Cyclopoida, Ostracoda and Cladocera, as well as by chelicerate taxa of the Class Arachnida, which includes hydracaranid water mites).

⁷ Source: Proposed Pebble Bed Modular Reactor Demonstration Power Plant, at the Koeberg Nuclear Power Station Site. Assessment of impacts to (surface) freshwater ecosystems. Dr Liz (E.) Day, The Freshwater Consulting Group (June 2009)

⁸ Source: Environmental impact assessment for the proposed nuclear power station ('Nuclear 1') and associated infrastructure – Wetland ecosystems. Liz Day, November 2009.

⁹ Sw1 and Sw2 wetlands have not been mapped since they occur as multiple depressions and detailed mapping of individual units would be highly complex. The entire mosaic of these wetlands is regarded as wetland and a critical wetland support area.

Sampling for aquatic invertebrate fauna at the site identified 80 taxa, 29 of which were microcrustaceans. Typical of many seasonal wetlands, the invertebrate community in all seasonally inundated wetlands was however dominated by insect taxa, with Coleopterans and Dipterans being the most species diverse groups present.

The seasonal wetlands were assessed to determine their Present Ecological Status (PES)¹⁰, leading to the assignment of PES categories to wetlands on the site. PES categories ranged from A/B (indicative of a largely unmodified wetland) to C – a wetland that has been moderately modified from its natural condition.

The wetlands were further assessed in terms of their Ecological Importance and Sensitivity (EIS). EIS scores for Sw1 and Sw2 indicate that they qualify as Class A wetlands, i.e. wetlands of very high conservation importance. The EIS of other seasonal wetlands on the site ranges from Class D (low or marginal importance) to Class B (high conservation importance).

Together, the seasonally inundated depression wetlands identified on the site are viewed as examples of an important habitat type, and one which is locally rare (in the context of the site and the west coast as a whole), and regionally highly threatened – seasonally inundated wetland depressions have been significantly impacted by agricultural and urban development, and rough estimates of the impacts to such wetlands in the Cape Metropolitan Area alone suggest that less than 3% of the natural extent of this wetland type may remain intact today. The examples that occur on the site are considered to be less impacted than most other examples of this wetland type in the region.

2.4.5.1.2 Artificial wetlands⁶

In addition to the natural wetlands that occur within the nature reserve, the site also includes a number of artificial wetland areas, which are the product of activities associated with the construction of the KNPS and include one seasonally inundated depression (Sw4). These occur in the vicinity of the existing KNPS, in places along internal roads, along the boundary fence line and in the northern portion of the site just north of the dune field (Figure 2-2). However, the area was used as a lay down area during construction of the KNPS and today comprises a flattened, homogeneous, disturbed area, portions of which have been mapped as degraded *Ficinia nodosa* wetland.

All of the permanently inundated wetlands on the site are believed to be artificial in origin, and include a combination of:

- Borrow pits (P1 and P2a-d shown in Figure 2-2).

These wetlands generally comprise steep-sided depressions, densely vegetated with indigenous pondweed *Potamogeton* sp. and/or *Typha capensis* and *Phragmites australis*. Permanent wetlands are predominantly

¹⁰ Present Ecological Status (PES) is assessed using a scoring methodology prescribed by the Department of Water Affairs, which requires the scoring of attributes associated with particular criteria (namely: hydrologic, water quality, hydraulic and biotic criteria). The mean of all scores is then used to place the wetland in a conservation class, with PES A defined as 'Unmodified or approximates natural condition', PES B defined as 'Largely natural with few modifications: a slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place'; Category C defined as 'Moderately modified: A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact', ranging to PES F, being defined as 'Critically modified. Losses of habitat and function are almost total, and the wetland has been modified completely'.

fed by groundwater, which tends to be brackish, with a high alkalinity. Aquatic invertebrate diversity in these wetlands is low, comprising relatively hardy taxa, dominated by air-breathing hemipterans.

- Coastal infiltration ponds in the northern section of the site (P3a-d) (Figure 2-2), excavated between the dunes.

These ponds are fed by treated industrial effluent and untreated stormwater runoff, piped from the Atlantis Industrial Area. Most comprise deep, permanent open water bodies, vegetated by plant species that thrive under conditions of nutrient enrichment. The ponds are prone to occasional algal and cyanobacterial blooms. Overall, the ponds are unnatural water features that provide low quality, but locally rare, permanent freshwater habitat for some biota, artificially contributing to plant and animal diversity in the area. They provide a hydraulic barrier for the protection of the greater Atlantis Aquifer from seawater intrusion.

- Ad hoc excavations into the water table

Most of these are reed-dominated systems, sometimes providing breeding habitat to birds such as Red Bishops and Cape Weavers.

The artificial wetlands and importance was thus simply ascribed to these wetlands. They are generally of low-to-moderate or moderate conservation importance.

Wetland ecosystems do not present any threat to the proposed nuclear installation(s) and will not result in any impact on the proposed nuclear installation(s). This is confirmed by the absence of any reported nuclear installation safety incidents relating to wetland ecology during the operating life of KNPS.

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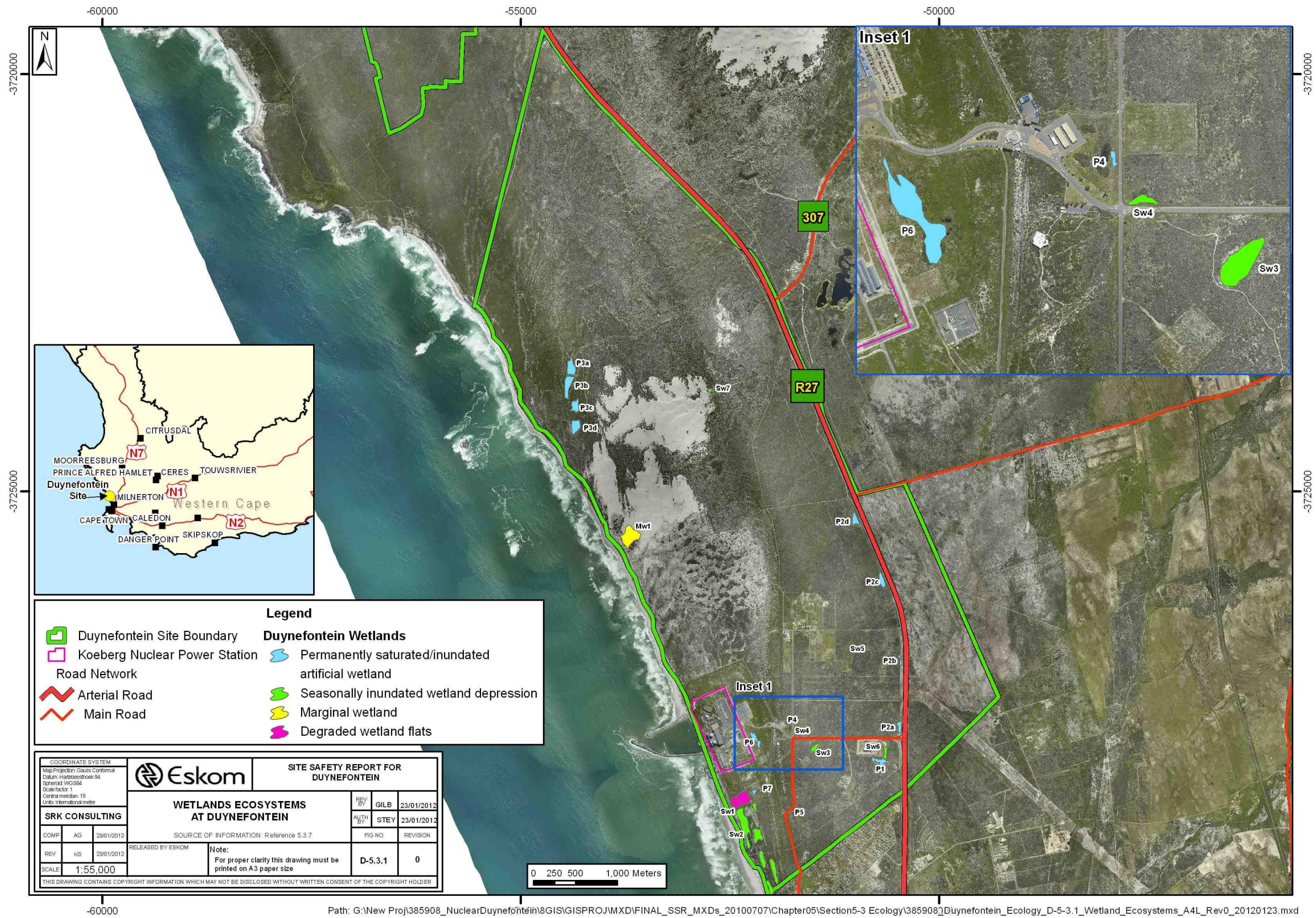


Figure 2-2 Wetland ecosystems within the Koeberg Nature Reserve

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2.4.5.2 Groundwater

There are two aquifers present within the Nature Reserve, namely:

- Aquifer 1: Primary Sandveld Aquifer (upper, intergranular); and
- Aquifer 2: Secondary Malmesbury Aquifer (basal, fractured-rock).

Virtually all groundwater production boreholes draw from the well-sorted, fine to medium grained quartz sand horizons of the upper Springfontyn Formation as it is usually the thickest formation present. The thickness of the primary aquifer at the site is between 14 and 27 m and the rest groundwater level occurs between 2 to 5 m below ground level (m bgl). The results of previous drilling at the KNPS indicate a profile of 3 to 4.5 m of slightly calcareous sand which becomes organic-rich and contains shell fragments below 7.5 m. The lower part of the primary aquifer consists of pebbly sand grading into gravels.

The secondary aquifer is a semi-confined system, which is in hydraulic connection with the overlying primary aquifer. Interpretation of previous pumping test results supports the hypothesis that upward leakage from the Malmesbury Aquifer to the primary aquifer can be expected if the water table in the sand is drawn-down below the piezometric level in the underlying semi-confined aquifer. These two aquifers are generally separated by a zone of weathered bedrock (clay).

The Atlantis Aquifer is a major primary aquifer with three production wellfields, namely the Witzand and Silwerstroom wellfields (both owned by the CoCT) and the Aquarius Wellfield (owned by Eskom), tapping it. The Aquarius and Witzand wellfields are situated in or overlaps with the Nature Reserve. The former wellfield supplies water to the site (for game watering currently) whilst the latter supplies Atlantis. The Silwerstroom Wellfield is situated north of the nature reserve and also supplies Atlantis. There are also many other existing boreholes in the area.

2.4.5.2.1 Groundwater Use

Five monitoring boreholes are situated around the two reactors at the KNPS (TW1 to TW5). These boreholes are presently solely used for groundwater monitoring purposes. A further six monitoring boreholes have also been drilled at the originally proposed PBMR DPP site (PBMR1 to PBMR6) to monitor groundwater levels, macro chemistry and H-3 concentrations in both the primary aquifer and underlying Malmesbury Aquifer. This monitoring programme commenced during February 2008, but was terminated in mid-2010 due to cancellation of the PBMR DPP project.

2.4.5.3 Marine Ecology¹¹

The Koeberg Nature Reserve is located towards the southern limit of the relatively uniform Namaqua marine biogeographic region, which extends north as far as southern Namibia. This region is dominated by the cold Benguela Current system, in which high biological productivity is supported by the upwelling of cool, nutrient-rich waters. However, the region is characterised by low marine species richness and very low endemism. A few south coast species' distributions extend into the region as far as the site, giving the site slightly elevated species richness and endemism rates when compared to more northern areas along this coast.

¹¹ Source: Environmental Impact Assessment for the Proposed Nuclear Power Station ('Nuclear-1') and Associated Infrastructure – Marine Ecology Impact Assessment. Professor CL Griffiths and Dr TB Robinson, March 2011.

This nature reserve is dominated by long sandy beaches, interspersed with short stretches of rocky shore. There are no sites of special conservation value for marine species within the immediate area. There are no estuaries present on the site.

The marine environment can be divided into a number of zones, namely the intertidal zone, the benthic environment and open water environment. Each of these zones is discussed below.

2.4.5.3.1 Intertidal Zone

The intertidal zone in the vicinity of the site is dominated by sandy shores. To the north of the KNPS is a 10 km-long sandy beach which is very wave exposed and, as a result, consists of coarse-grained quartz sand and comminuted shell. To the south is a shorter beach, which is more sheltered due to the presence of the KNPS cooling water basin structure. This shore consists of finer sediment and has a wider intertidal zone. Due to the dynamic nature of exposed sandy shores (as a result of the dominance of physical parameters such as water movement), these beaches demonstrate high tolerance to disturbance and are rated as low sensitivity habitat.

Sandy beaches typically support a low number of species and all the beach species found at the site have extensive geographical distributions and are typical of the west coast. During sampling at the site, only a single species endemic to South African shores was recorded, namely the amphipod *Talorchestia quadrispinosa*. However, this species has a range spanning from False Bay up the entire West Coast.

High-shore macrofaunal communities are dominated by crustaceans (isopods and amphipods), while lower down the shore, communities are dominated by polychaete worms. Although not numerically dominant, the White sand mussel *Donax serra* also occurs in the low shore. This species is common on exposed sandy beaches along the west and south coast.

Very little natural rocky shore is present along the western boundary of the nature reserve and the two KNPS harbour breakwaters represent the largest section of hard substratum available in the intertidal zone.

A number of marine birds are known to breed in the intertidal zone around the nature reserve. These include Hartlaub's gull *Larus hartlaubii*, the Swift tern *Sterna bergii*, the Bank cormorant *Phalacrocorax neglectus* (Endangered), the Crowned cormorant *P. coronatus* (Near Threatened), Cape cormorant *P. capensis* and the African black oystercatcher *Haematopus moquini* (Near Threatened). Of these, two species are endemic to the South African West Coast (Hartlaub's gull and the Bank cormorant) and the African black oystercatcher is endemic to the South African west and south coast.

Recent research has identified the KNPS cooling water basin and surrounding Koeberg Nature Reserve as an area of significant conservation importance, which meets the criteria for classification as both a Ramsar site (i.e. a wetland of international importance) and an Important Bird Area (i.e. essential bird habitat). In particular, the protection offered by the nature reserve has resulted in a notable increase in density of breeding pairs of the African black oystercatcher, which has recently been reclassified as Near Threatened after being rated as Endangered for a number of years.

Besides the marine birds occurring near the site, African penguin *Spheniscus demersus* and other seabird colonies are located at Robben Island, about 15 km to the southwest.

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2.4.6 Vegetation Types¹² and Conservation Status

The Cape Floristic Kingdom, one of six world floral kingdoms, is internationally renowned for its special rich flora containing an estimated 9 000 species of vascular plants of which almost 69% are endemic (restricted to the region). This makes it one of the richest regions in the world in terms of botanical diversity. It is characterized by five endemic families and by the conspicuous presence of, amongst others, species belonging to the families Aizoaceae, Ericaceae, Fabaceae, Iridaceae, Orchidaceae, Proteaceae, Restionaceae, Rutaceae and Scrophulariaceae (Goldblatt & Manning, 2000).

In total, 380 plant species have been recorded from the Koeberg Nature Reserve, with a rare species count of 34 (or 8.9%). Species rarity is extremely low for most of the site, except for the sand plain fynbos, where species rarity and localised endemism is highest. Species rarity is substantially lower on the transverse dunes and this is echoed in the low endemism there.

The two main vegetation types found on the site: Cape Flats Dune Strandveld and Atlantis Sand Fynbos, both located within the Fynbos Biome (Mucina & Rutherford, 2006).

There is general correlation between soil characteristics and plant community, with the grouping into calcareous dunes and non-calcareous sand plain fynbos. Vegetation type rarity at the site is high, with both of these major vegetation types classified as Endangered. Sensitivity is locally high due to the presence of mobile and potentially mobile dune sand, with fire proneness being high in the fynbos communities.

Eleven associated plant communities were identified at the site, including one wetland community. The eleven plant communities (K1 to K11) that occur on the site are listed below:

- primary and foredunes (communities K1 and K2);
- mobile and semi-mobile transverse dunes (community K3);
- transition between transverse and parabolic dunes (community K4);
- stable parabolic dunes (communities K5, K6, K7 & K8);
- calcrete and limestone (community K9);
- sand plain fynbos (community K10);
- dune slack wetland in south (community K11).

Additional detail on these eleven plant communities is provided in Table 2-4 and these are mapped and illustrated in Figure 2-3 and Figure 2-4.

Habitat rarity at the site is particularly high in the south-eastern flats which support sand plain fynbos, while the transverse dunes also rate high. Similarly, combined values for site sensitivity indicate that the transverse dunes and the sand plain fynbos in the south-east possess high sensitivity, with the wetland in the south accorded very high sensitivity.

¹² Source: Environmental Impact Assessment for the Proposed Nuclear Power Station ('Nuclear-1') and Associated Infrastructure: Botanical and Dunes Impact Assessment. Johannesburg. Eskom, 2009.

Table 2-4 Plant Communities and Summary of Species Data at the Koeberg Nature Reserve Site

Map Ref.	Community	Description	Total Plant Species (# Red List spp)	Study Area ha (Area %)
Calcareous Sands and Limestones				
K2	Primary and foredunes	Pioneer vegetation of the coastal dunes localised in a narrow strip along the coast. Plant cover is rarely more than 0.5 m tall and is sparse to mid-dense, with both dune fynbos and dune thicket elements. Key species include <i>Amphibolia laevis</i> kusduinevygie, <i>Arctotheca populifolia</i> sea pumpkin, <i>Cladoraphis cyperoides</i> steekriet, <i>Dasispermum suffruticosum</i> duineseldery, <i>Didelta carnosa</i> subsp. <i>tomentosa</i> seegousblom, <i>Ficinia lateralis</i> dune sedge, <i>Helichrysum niveum</i> , <i>Manulea tomentosa</i> duinevingertjies, <i>Metalasia muricata</i> blombos, <i>Morella cordifolia</i> dune waxberry, <i>Passerina ericoides</i> kusgonnabas, <i>Psoralea repens</i> duine-ertjie, <i>Pelargonium capitatum</i> rose-scented pelargonium, <i>Senecio elegans</i> wild cineraria, <i>Senecio maritimus</i> strandhongerblom and <i>Trachyandra divaricata</i> duinekool.	67 (3)	37.4 (1,3)
K3	Mobile and semi-mobile transverse dunes	Pioneering plant community found inland of the coast, displaying close linkages with the coastal primary dunes and foredunes. Vegetation is successional to dune thicket, but only if the sand stabilises. Plant height reaches 2 m with species such as <i>Seriphium plumosum</i> slangbos, but in general tends to be low (0.5 to 1 m). Key species include most of those mentioned in Communities K1 and K2, but with <i>Carpobrotus acinaciformis</i> suurvly, <i>Ehrharta villosa</i> pyppgras, <i>Chrysanthemoides incana</i> grysbietou, <i>Cladoraphis cyperoides</i> steekriet, <i>Hellmuthia membranacea</i> knopbiesie, <i>Lessertia frutescens</i> kankerbos, <i>Otholobium bracteolatum</i> skaapbostee, <i>Rhus laevigata</i> duinetaabos and <i>Ruschia macowanii</i> bosvygie becoming more prominent.	51 (4)	808.6 (28,9)
K4	Transition between transverse and parabolic dunes	Transition between transverse and parabolic dunes, comprises elements of both mobile/semi-mobile transverse dunes, and the more stable parabolics abutting the former.	N/A	113.3 (4,1)

Map Ref.	Community	Description	Total Plant Species (# Red List spp)	Study Area ha (Area %)
K5 K6 K7 K8	Stable parabolic dunes	<p>These communities represent the climax or mature stage of dune thicket on the West Coast. They can form dense thicket of 3 m and taller, with little to separate these communities except height. They are dominated by broad-leaved shrubs including <i>Euclea racemosa</i> seeghwarrie, the semi parasite <i>Osyris compressa</i> Cape sumach, <i>Olea exasperata</i> slanghout, <i>Pterocelastrus tricuspidatus</i> kershout, <i>Putterlickia pyracantha</i> basterpendoring, <i>Rhus crenata</i> duinekraaibessie, <i>Rhus glauca</i> bloukoeniebos, <i>Rhus lucida</i> blinktaaibos and <i>Salvia africana-lutea</i> bruinsalie. <i>Helichrysum dasyanthum</i>, <i>Helichrysum revolutum</i> vaalsewejaartjie, <i>Pelargonium gibbosum</i> dikbeenmalva, <i>Solanum africanum</i> melkellie and <i>Tetragonia fruticosa</i> kinkelbossie, all sub-woody shrubs, are locally found. Climbers are invariably present and include <i>Cissampelos capense</i> fynblaarklimop, <i>Cynanchum africanum</i> bobbejaantou, <i>Kedrostis nana</i> ystervarkpatats, and <i>Asparagus aethiopicus</i> haakdoring. Succulence is also locally prominent with species including <i>Cotyledon orbiculata</i> varkoor, <i>Euphorbia burmannii</i> steenbokmelkbos and <i>Euphorbia mauritanica</i> geelmelkbos. The understorey is often colonised by the perennial herb <i>Cineraria geifolia</i> cineraria, and shade-tolerant annuals such as <i>Didymodoxa capensis</i> and <i>Torilis arvensis</i>, as well as a number of grasses including <i>Ehrharta brevifolia</i> var. <i>brevifolia</i> and <i>Ehrharta calycina</i> rooigras.</p> <p>Openings and slacks (valleys) in the dunes lend themselves to supporting a fragmented dune fynbos community which is successional to thicket. A very different species assemblage is found here, with a lower cover and height. Typical species are <i>Afolimon peregrinum</i> strandroos, <i>Anthospermum prostratum</i>, <i>Chrysanthemoides monilifera</i> bietou, <i>Cineraria geifolia</i> cineraria, <i>Helichrysum niveum</i>, <i>Hermannia pinnata</i> kwasblaarkruippopros, <i>Jordaniella dubia</i> helderkruipvygie, <i>Nylandtia spinosa</i> skilpadbessie, <i>Othonna coronopifolia</i> sandbobbejaankool, <i>Ruschia macowanii</i> bosvygie, <i>Thesium spicatum</i> lidjes'tee and <i>Roepera flexuosa</i> spekbossie. It is in these open parts that the mass displays of spring annuals are to be found on the West Coast, and these include <i>Cotula turbinata</i> ganskos, <i>Crassula glomerata</i> brakvygie, <i>Dimorphotheca pluvialis</i> witbotterblom, <i>Dischisma ciliatum</i>, <i>Heliophila coronopifolia</i> blouflaks, <i>Hemimeris racemosa</i> geelgesiggie, <i>Nemesia affinis</i> weeskindertjie, <i>Senecio arenarius</i> hongerblom, <i>Senecio littoreus</i> geelhongerblom and <i>Zaluzianskya villosa</i> drumsticks.</p> <p>The graminoid (grass-like) component includes <i>Ficinia indica</i> knoppiesbiesie, <i>Ischyrolepis eleocharis</i> katsterriet, <i>Isolepis antarctica</i>, <i>Ehrharta calycina</i> rooigras, <i>Ehrharta villosa</i> pyggras and <i>Pentaschistis pallida</i>. Locally, the tall thatching reed, <i>Thamnochortus spicigerus</i> can become dominant. Geophytes (bulbs) tend to be found in more open terrain. Species include <i>Zantedeschia aethiopica</i> arum lily, <i>Albuca flaccida</i> geldbeursie, <i>Brunsvigia orientalis</i> koningskandelaar, <i>Gladiolus cunonius</i> rooipypie, <i>Haemanthus coccineus</i>, <i>Lachenalia rubida</i> sandviooltjie and <i>Trachyandra ciliata</i> wildeblomkool.</p>	333 (12)	997 (35,0)
K9	Calcrete and limestone community	<p>This community is fragmented and occupies such small areas that it is not possible to map at this scale. However, it possesses a distinct flora with key species including <i>Rhus</i> spp. Taaibos, <i>Asparagus</i> spp. haakdoring, <i>Euclea racemosa</i> seeghwarrie, <i>Ischyrolepis eleocharis</i> katsterriet, and <i>Roepera flexuosa</i> spekbossie. This substrate is rarely exposed on the site, invariably in the central parabolic dunes, but also along the coast. Here the predominant flora is pioneering species such as those outlined above under K1 and K2.</p>	42 (0)	N/A

Vegetation of neutral to acid sands				
K10	Sand plain fynbos	This plant community is confined to the south-eastern flats of the site and is found on older deflated dunes. The vegetation is fynbos dominated by restios and ericoid-leaved species, with the occasional protea. Plant cover is moderate with heights rarely exceeding 1 – 2 m. Species prominent in this community include <i>Adenogramma glomerata</i> muggiegras, <i>Afolimon purpuratum</i> , papierblom, <i>Dorotheanthus bellidiformis</i> subsp. <i>bellidiformis</i> bokbaai vygie, <i>Diosma hirsuta</i> , rooiboegoe, <i>Erica mammosa</i> , rooiklossieheide, <i>Ficinia indica</i> knoppiesbiesie, <i>Grielum grandiflorum</i> platdoring, <i>Leucadendron levisanus</i> Cape Flats conebrush, <i>Metalasia muricata</i> blombos, <i>Nemesia strumosa</i> balsamienie, <i>Passerina corymbosa</i> sandgonnabas, <i>Plecostachys serpyllifolia</i> vaaltee, <i>Polycarena capensis</i> geelopslag, <i>Rhus laevigata</i> duinetaabos, <i>Senecio halimifolius</i> tabakbos, <i>Senecio hastatus</i> groundsel, <i>Serruria decipiens</i> Weskusspinnekopbos, <i>Thamnochortus erectus</i> wyfieriet and <i>Thamnochortus obtusus</i> .	124 (1)	624,3 (3,8)
Wetlands				
K11	Dune slack wetland in south	Only one wetland in the south was sampled, displaying a relatively low species complement with typical taxa including <i>Ficinia nodosa</i> steekbiesie, <i>Nidorella foetida</i> vleikruid, <i>Plecostachys serpyllifolia</i> vaaltee, <i>Sarcocornia pillansii</i> brakbos and <i>Senecio halimifolius</i> tabakboss.	31 (2)	3,7 (0,1)
Transformed Land				
-	Developed areas, KNPS		N/A	209,7 (7,5)
TOTAL			380 (34)	2 791,9 (100,0)

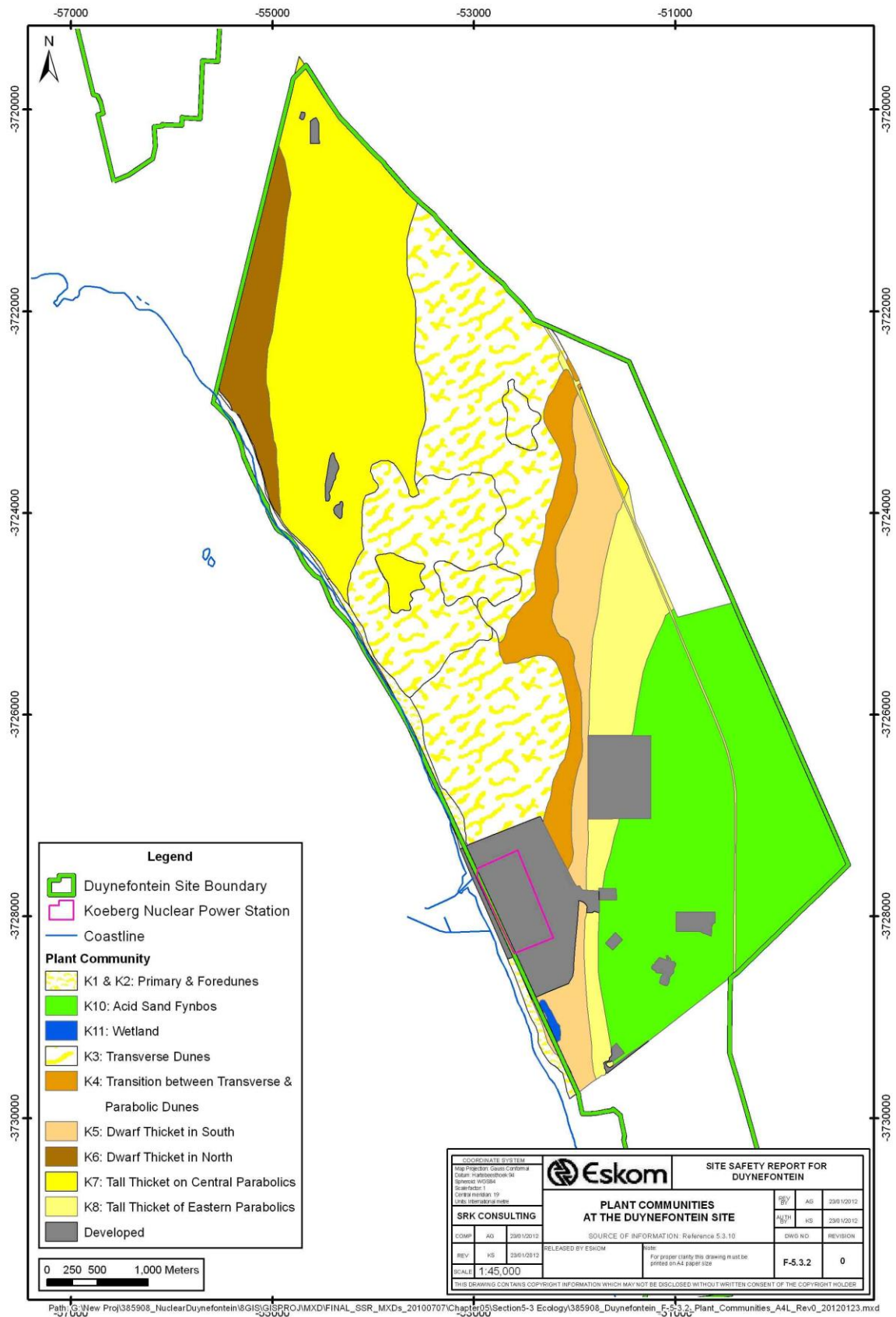


Figure 2-3 The plant communities within the Koeberg Nature Reserve

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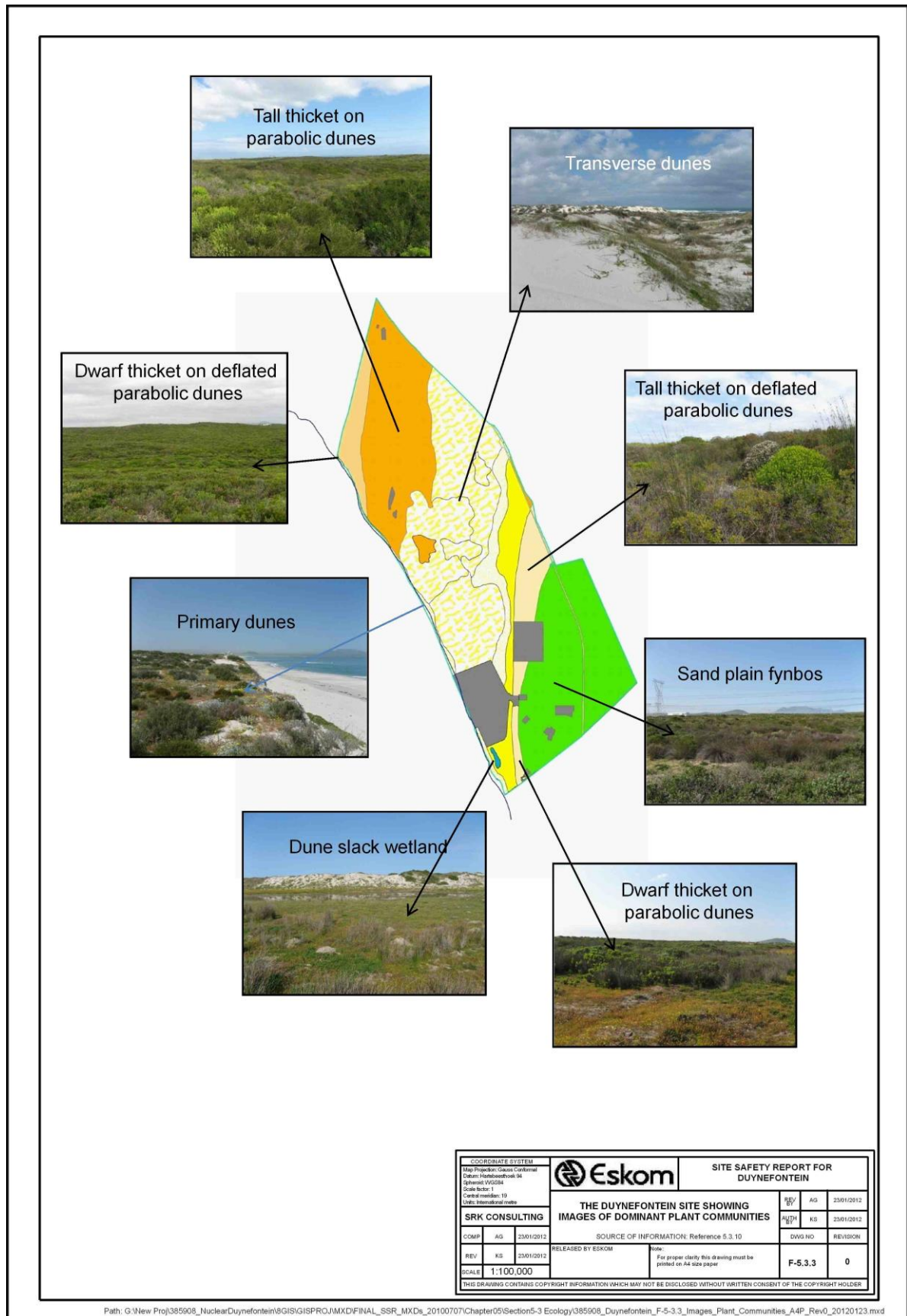


Figure 2-4 Images showing the dominant plant communities

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The following vegetation types (Mucina & Rutherford, 2006) within the Fynbos Biome are located within the Koeberg Nature Reserve, as shown in Figure 2-5:

- Atlantis Sand Fynbos (FFd 4) – Critically Endangered¹³;
- Cape Flats Dune Strandveld (FS 6) – Critically Endangered¹³; and
- Cape Seashore Vegetation (AZd 3) – Least Threatened.

The Cape Seashore Vegetation (AZd 3) unit is recognised along the seashore or strand bordering the western coastal boundary of the Koeberg Nature Reserve.

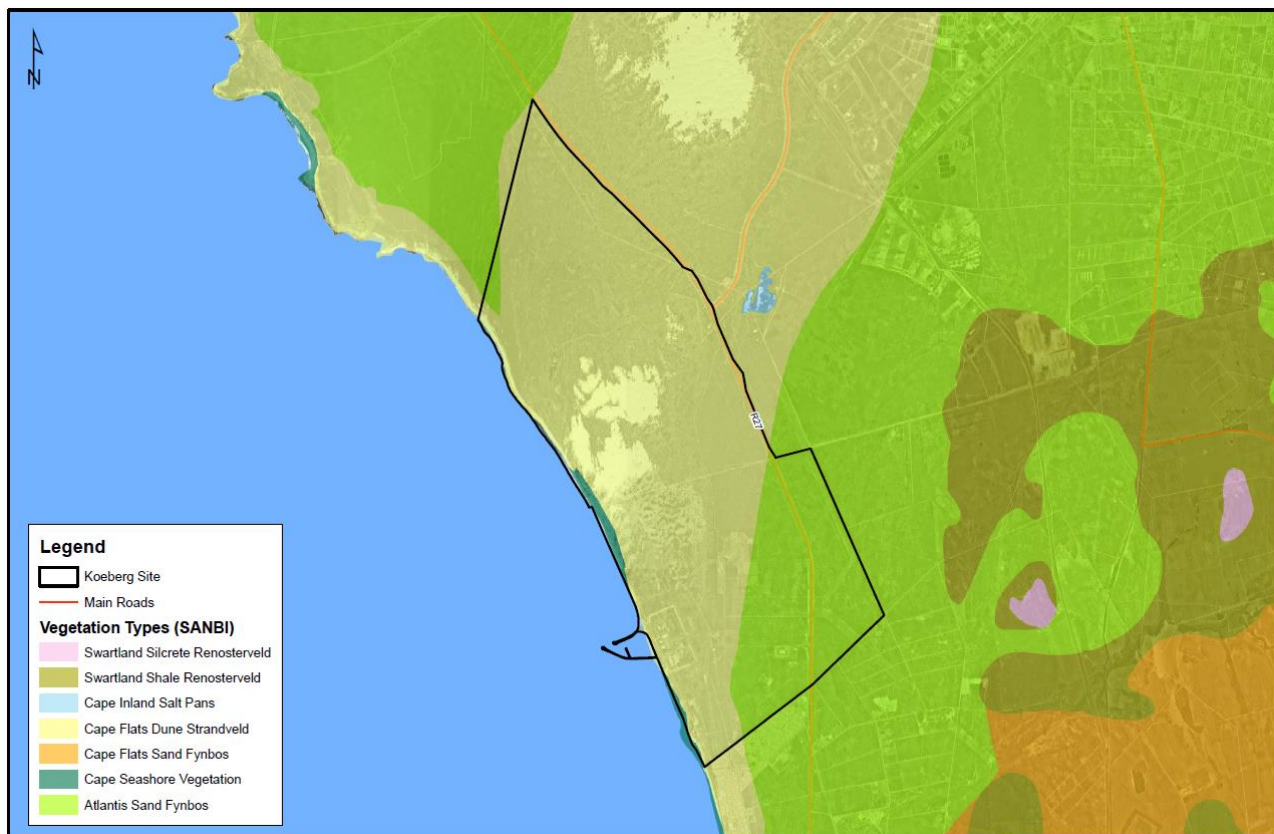


Figure 2-5 Vegetation types found on the Koeberg Nature Reserve Site

A detailed botanical species list produced by the SaSFLORE database as part of the Nuclear 1 Environmental Impact Assessment (EIA) has been included Appendix C.

2.4.6.1 Sand Plain Fynbos

The sand plain fynbos is the second largest unit accounting for 15% of the total area within the Fynbos Biome. It is almost entirely coastal, occurring on Quaternary and Tertiary sand of marine and aeolian origin. The deep sand on the West Coast reflects a broad soil-reaction gradient, spanning acidic, neutral to alkaline. All alkaline sands on the West Coast support strandveld. The dominant structural type of sand fynbos depends on the water table. Where water tables are deep (access to rainfall in winter only) restioid fynbos dominates, usually with marked absence of shrubs. Where the water table is more accessible, Asteraceous fynbos may occur. And at relatively shallow and non-fluctuating water tables proteoid fynbos dominates.

¹³ Status of vegetation types as classified in the National list of ecosystems that are threatened and in need of protection, December 2011. NEM: Biodiversity Act (2004)

On the aridity gradient to the north of the West Coast, Ericaceae are the first to disappear, so that only FFd 5 Cape Flats Sand and FFd 4 Atlantis Sand Fynbos retain a marked ericaceous component.

The boundary of the sand plain fynbos with strandveld is a dynamic one, powered by sparseness of the vegetation not supporting fire and by dune topography.

Sand plain fynbos is a fire driven system and have a burn cycle of 8 to 15 years.

2.4.6.1.1 Atlantis Sand Fynbos

The Atlantis Sand Fynbos vegetation unit has greater species diversity than the sand fynbos units to the north of the Koeberg Nature Reserve, and this exemplifies the northern limit of extensive ericaceous fynbos in sand fynbos.

This vegetation unit covers a small portion in the north-western corner of Remainder of Cape Farm 33 (Springfontyn) and the south-eastern half of Cape Farm 34 (Duynefontein) of the Koeberg Nature Reserve.

This vegetation unit has moderately undulating to flat sand plans with dense, moderately tall, ericoid shrubland dotted with emergent, tall sclerophyllous shrubs and an open, short restioid stratum. The restioid and proteoid fynbos are dominant, with asteraceous fynbos and patches of ericaceous fynbos in seepages.

The conservation status of this vegetation type is Critically Endangered (DEA, 2011, with a conservation target of 30%. About 6% of the surface of the unit is currently protected. Some 40% has been transformed, mainly for cultivation (agricultural smallholdings and pastures), by the urban sprawl of Atlantis and for setting up pine and gum plantations. Another treat to this vegetation unit is the woody aliens such as *Acacia saligna*, *A. cyclops* and various *Eucalyptus* and *Pinus*.

2.4.6.2 Western Strandveld

The Western Strandveld currently consists of nine vegetation units of which six of these units are found on the dry West Coast.

Strandveld vegetation is usually found close to the sea but never in habitats under direct influence of sea spray or other factors associated with the influence of the sea water; usually these habitats are occupied by the azonal coastal vegetation.

As opposed to the sand fynbos, the substrate of the strandveld is mineral-rich, with high concentrations of calcium. Unlike in fynbos and renosterveld, fire plays a lesser role in strandveld communities. Despite high cover of the strandveld shrublands, fire frequency is low, i.e. fire cycle of 20 to 100 years. However, the succulent nature of strandveld impedes the spread of fire, except under exceptional conditions.

2.4.6.2.1 Cape Flats Dune Strandveld

The Cape Flats Dune Strandveld vegetation unit has a flat to slightly undulating (dune fields) landscape covered with tall, evergreen, hard-leaved shrubland with abundant grasses and annual herbs in gaps.

This vegetation unit covers the north-western half of Cape Farm 34, Duynefontein and the entire portion 6 of Cape Farm 33 (Kleine Springfontyn), portion 5 of Farm 2 Witzand and the majority of the remainder of Cape Farm 33 (Springfontyn) within the Koeberg Nature Reserve.

The conservation status of this vegetation type is Critically Endangered (DEA, 2011), with a conservation target of 24%. More than 6% of the surface of the unit is statutorily conserved national and private nature reserves. Almost 40% has already been transformed by urban sprawl, road construction or cultivation. Alien species of *Acacia*, pines and gum trees (*Eucalyptus*) have replaced the original strandveld vegetation in large areas.

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2.4.6.3 Dry Seashore Vegetation

The dry seashore vegetation units' classification is a synthetic product of habitat and biogeographical subdivisions of the coast (and adjacent to sea waters). Four groups have been recognised of which the "seashore vegetation" unit stretches along the western boundary of the Koeberg Nature Reserve.

2.4.6.3.1 Cape Seashore Vegetation

The Cape Seashore Vegetation unit is described as having beaches, coastal dunes, dune slacks, and coastal cliffs of open grassy, herbaceous and to some extent also dwarf-shrubby vegetation, often dominated by single pioneer species. Various plant communities reflect the age of the substrate and natural disturbance regime (moving dunes) distance from the upper tidal mark and the exposure of dune slopes (leeward versus seaward).

The vegetation is constantly under various pressures, such as salt spray from the sea, strong winds, windblown sands and fluctuating temperatures. The plant species found in this community have adapted in many ways so as to tolerate these harsh conditions. Some of them are succulent and hairy to prevent dehydration, while most are low growing or stunted to reduce the wind impact, seldom growing over 50 cm in height.

The conservation status of this vegetation type is Least Threatened, with a conservation target of 20%. Almost 50% of the surface of the unit is statutorily conserved in various national parks, nature reserves and private conservation areas to protect a considerable portion of this vegetation unit. Only about 1.7% has been transformed, mainly by urban development.

The vegetation species list is included in Appendix C.

2.4.7 Terrestrial Invertebrate Fauna

Invertebrates include the arthropods, which constitute the majority (over 75%) of all described species of living organisms on earth, and make up over 95% of all known animal species. Insects and other invertebrates are vital to the functioning of the earth's ecosystems, with virtually every aspect of ecosystem functioning being dependent in some way on insects. The discussion on terrestrial invertebrates is based on the information contained in the EIA for the Proposed Nuclear Power Station ('Nuclear-1') and Associated Infrastructure: Terrestrial Invertebrate Fauna. Johannesburg (Eskom, 2009).

The site is locally quite varied and comprises a mix of unvegetated or partially vegetated dune systems, as well as completely stabilised sand flats in the more inland parts. A summary of the diversity of the various taxa sampled is provided in Table 2-5:

Table 2-5 Summary of Invertebrate Taxa Diversity

Taxon	Description of findings
Ants	A total of 22 ant species were collected, with an estimated diversity of approximately 27 species. No Argentine Ant (<i>Linepithema humile</i>) specimens were found but these may occur on the site closer to the existing developments, where no surveys were carried out. Two ant species of special interest were collected at the site: these were <i>Tetramorium</i> sp. (a new species related to <i>T. flaviceps</i>) and <i>Monomorium</i> sp. (a probable new species related to <i>M. damarense</i>).
Butterflies	The summed probable total species count for this site is low at 23.1 with a very low Red List species probability of 0.01. A partial search did not reveal any Red-listed <i>Chrysoritis dicksoni</i> , which used to occur in similar habitat in the region. The most dominant species, which varied according to vegetation type, included <i>Chrysoritis pyroeis pyroeis</i> , <i>Chrysoritis thysbe thysbe</i> <i>f. osbecki</i> and <i>C. f. felthami</i> (36%).
Velvet worms (Onchyophora)	None found.

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Mygalomorph spiders (Arachnida: Araneae: Mygalomorphae)	One specimen of <i>Harpactira atra</i> , a protected baboon spider species common in the south-western Cape, was observed during the survey; another was also seen by the terrestrial vertebrate fauna investigation team.
Scorpions (Arachnida: Scorpiones)	No scorpions were encountered during the surveys, but conditions were poor and it would be premature to conclude that there are no scorpions on the site.
Soldier flies (Mydidae)	None found.
Heelwalkers (Mantophasmatodea)	None found.
Monkey beetles (Hopliini)	Several specimens of one species found; most were inactive and hiding under rocks.
Millipedes (Myriapoda)	Three species found.
Jewel beetles (Buprestidae)	None found.
Spoonwing lacewings (Nemopteridae)	None found.

The site has a moderate invertebrate diversity, with very few rare or relictual species observed or predicted.

2.4.8 Terrestrial Vertebrate Fauna¹⁴

2.4.8.1 Herpetofauna

2.4.8.1.1 Amphibians

There are nine possible species of amphibians that potentially occur at the site, eight of which are of probable or confirmed occurrence. One threatened species, the Cape Caco *Cacosternum capense* (Vulnerable), could possibly breed in seasonal wetlands. Rose's Rain Frog *Breviceps rosei* is a Western Cape endemic species confined to coastal dune habitats. Maintenance of a coastal corridor is important to prevent fragmentation of this species' distribution range.

The amphibian species list is included in Appendix C.

2.4.8.1.2 Reptiles

There are 53 possible species occurring in the region, 40 of which are of probable or confirmed occurrence within the Koeberg Nature Reserve. Two Red Listed species, Gronov's dwarf burrowing skink *Scelotes gronovii* (Near Threatened) and Southern adder *Bitis armata* (Vulnerable) are of probable occurrence, and one, Blouberg dwarf burrowing skink *Scelotes montispectus* (Near Threatened), is of confirmed occurrence. As with Rose's Rain Frog, these species are Western Cape endemics confined to coastal habitats. Maintenance of a coastal corridor is important to prevent fragmentation of their distribution range.

Reptiles include the Cape Cobra (*naja nivea*), Mole snake (*Pseudaspis cana*), boomslang (*Dispholidus typus*) and the angulate tortoise (*Chersina angulata*).

The reptile species list is included in Appendix C.

¹⁴ Source: Eskom (2009), Environmental Impact Assessment for the Proposed Nuclear Power Station ('Nuclear-1') and Associated Infrastructure: Terrestrial Vertebrate Fauna Impact Study.

2.4.8.2 Avifauna

There are 203 species of possible occurrence, 158 of which are probable or confirmed. Several threatened seabird species occur on the coast, e.g., Crowned cormorant *Phalacrocorax neglectus* (Near Threatened), Bank cormorant *Phalacrocorax coronatus* (Endangered), Caspian tern *Hydroprogne caspia* (Near Threatened).

More than 172 bird species have been identified in the Nature Reserve and include the Blackshouldered Kite (*Elanus caeruleus*), Cape francolin (*Francolinus capensis*), African Black Oystercatcher (*Haematopus moquini*), Cape Bulbul (*Pycnonotus capensis*) and the Cape Robin (*Cossypha caffra*) to name but a few.

The relatively protected environment in and around the KNPS cooling water intake basin provides excellent habitat for seabirds and shorebirds to roost and even breed. Swift terns *Sterna bergii* and African black oystercatchers *Haematopus moquini* (Near Threatened), in particular, have been recorded annually breeding there in significant numbers and these represent regionally important breeding. The population totalled 77 adults, 2 fledged juveniles and 2 chicks in the March 2001 survey.

Several threatened raptor species occur on site. The Black Harrier *Circus maurus* (Near Threatened) is known to breed at the site and the Marsh Harrier *C. ranivorus* (Vulnerable) may breed in the large coastal wetland area in the northern part of the site.

The avifauna species list is included in Appendix C.

2.4.8.3 Mammals

There are 56 possible species, 39 of which are of probable or confirmed occurrence. Two Red Listed species may occur on the Nature Reserve, viz. the Honey badger *Mellivora capensis* and the White-Tailed mouse *Mystromys Albicaudatus*. Local research suggests that the mouse is more likely to occur on heavy soils than on sandy soils, so its occurrence at the site may be limited to relatively small patches of suitable habitat, and these are not likely to be situated near to the coast. The Honey Badger has been recorded within the Koeberg Nature Reserve (Source: Photographs from trap cameras placed in the Nature Reserve). Four species of bat that have the status of Near Threatened are likely to be only visitors to the site, with their roosting and breeding sites elsewhere.

A number of different species occur on the Nature Reserve and include:-

- Steenbok (*Raphicerus campestris*) – Introduced,
- Duiker (*Sylvicapra grimmia*) – Introduced,
- Springbok (*Antidorcas marsupialis*) – Introduced,
- Burchell's zebra (*Equus burchelli*) – Introduced,
- Eland (*Taurotragus oryx*) – Introduced,
- Gemsbok (*Oryx gazella*) – Introduced,
- Blue Wildebeest (*Alcelaphus buselaphus*) – Introduced,
- Caracal (*Felis caracal*) and
- The small grey mongoose (*Galerella pulverulenta*).

The management of game forms part of a Koeberg Nature Reserve Game Management Plan. The mammalian species list is included in Appendix C.

2.4.9 Cultural Heritage context of Koeberg Nature Reserve

The existing KNPS and the Nature Reserve has become an accepted landmark in the mind of most Capetonians.

CONTROLLED DISCLOSURE

When the bulk excavations were undertaken on site in the 1970s fossiliferous deposits were encountered in several of the geological strata that were affected. Furthermore, Pleistocene fossils and Early Stone Age artefacts were encountered. Archaeologists from the Iziko Museum of Cape Town then conducted a survey of what is today the Koeberg Nature Reserve noting the presence of Late Stone Age middens from the Holocene, as well as Pleistocene fossil bone accumulations at several localities within the nature reserve (Klein and Avery pers. comm.). Following these findings, the Nature Reserve hosts major palaeontological research operations by international scientists.

During physical surveys conducted as part of the Nuclear 1 EIA¹⁵ it was revealed that the heritage significance of the site varied. No colonial period heritage sites were found while heritage sites relating to the Late Stone Age are few. The heritage significance of the Duynefontein option relates to its Miocene palaeontological and Pleistocene archaeological and palaeontological deposits.

The heritage survey did not reveal any aspects of the cultural landscape and associated person-made structures that are of any particular significance, or protected by the National Heritage Resources Act, No. 25 of 1998.

2.4.10 Socio-economic context¹⁶

Based on an assessment of the community profiles in the vicinity of the KNPS, it was shown that approximately 79 030 people reside in the within a 15 km radius of the KNPS and Nature Reserve. The suburbs of Avondale and Saxonsea in Atlantis to the north-northeast contained the highest population concentration (i.e. approximately 21 910 and 13 240 persons, respectively). The neighbourhoods of Duynefontein (1 412 persons), Van Riebeeckstrand (1 341 persons) and a portion of Melkbosstrand (approximately 1 460 persons) form the largest settlement located south of the Nature reserve, with approximately 4 210 residents in 2001.

According to the data approximately 20 305 dwellings are found in the surrounding areas. The majority of the dwellings (approximately 93 per cent) are of a formal nature (such as houses, townhouse and flats) and approximately 7 per cent of the dwellings are of an informal nature (such as shacks).

The land surrounding the Nature Reserve is a mixture of land uses which consists of urban, rural and farming areas.

The presence of the KNPS ensures that development surrounding the nuclear facility and the Nature Reserve are controlled and/or monitored to ensure that no change of land use which may give rise to activities that may pose an external threat to the KNPS, and resultantly minimise the impact of development on the boundaries and integrity of the Nature Reserve. The KNPS is required to maintain a 0 to 5 km Protective Action Zone (PAZ) and a 5 to 16 km Urgent Protective Action Zone (UPZ) by the NNR to be implemented around a nuclear facility for safety purposes. No new developments will be allowed to be built within the PAZ and existing and planned developments situated within UPZ are required to be included in the facility's emergency evacuation plan.

The KNPS employs up to 2 000 people, who enters the Nature Reserve on a daily basis. During outages over 3 000 people are employed. The Nature Reserve also provides controlled access to the general public for recreational use of the Nature Reserve.

In the past the local community could apply for permits to harvest wood from *A. saligna* and *A. cyclops* trees within the Nature Reserve on an *ad hoc* basis.

The Atlantis Aquifer has three production wellfields, namely the Witzand and Silwerstroom wellfields (both owned by the CoCT) and the Aquarius Wellfield (owned by Eskom), whereas the Aquarius and

¹⁵ Source: Environmental Impact Assessment for the Proposed Nuclear Power Station ('Nuclear 1') and associated infrastructure – Heritage Impact Assessment. Archaeology Contracts Office, October 2010.

¹⁶ Source: Environmental Impact Assessment for the Proposed Nuclear Power Station ('Nuclear 1') and associated infrastructure – Social Impact Assessment. Octagonal Development cc, March 2011.

Witzand wellfields are situated in or overlaps with the Nature Reserve. The former wellfield currently supplies water for game in the Nature Reserve, whilst the latter supplies water to Atlantis. The Silberstroom Wellfield is situated north of the Nature Reserve and also supplies Atlantis.

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