ESKOM HOLDINGS LIMITED
GENERATION DIVISION

NUCLEAR 1 ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME

SPECIALIST STUDY FOR SCOPING REPORT

SPECIALIST STUDY: **Wetland ecosystems**

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J27035

August 2007

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CONTENTS

1 EXECUTIVE SUMMARY

Five sites were qualitatively assessed in this Scoping phase of the EIA process, using information from existing and readily accessible literature, previous knowledge of some of the sites and cursory site visits undertaken. Of the five sites, no wetland habitats are believed to be associated with the two Northern Cape sites, Brazil and Schulpfontein. The remaining three sites all include extensive wetlands of high conservation importance as well as, in the case of the Duynefontein site, artificial wetlands of low and medium conservation importance.

The following main **negative** impacts to freshwater ecosystems were identified: as potentially associated with the proposed development:

- Infilling or other means of destruction of wetlands to accommodate building platforms, infrastructure or lay-down areas during construction
- Physical disturbance to wetlands during construction or subsequent phases
- Drainage of wetlands during construction-associated dewatering of excavations
- Disruption of surface/ groundwater interactions
- Disposal of sewage effluent from residential areas developed to house construction or operational phase personnel.

Two potential **positive** impacts were also redflagged, namely:

- Active management of invasive alien vegetation, although it was noted that clearing of listed aliens is the legal duty of all landowners and should therefore take place even without the development
- Protection of ecologically meaningful extents of natural areas from piecemeal development and edge impacts.

The following issues potentially limit or at least challenge the proposed project:

- The need to treat construction and operational phase sewage to an ecologically acceptable water quality standard and dispose of it without incurring adverse ecological effects
- The locations of wetland corridors both within and outside of the proposed sites – these pose challenges to the routing of pylons, pipelines and access roads from the sites to other centres.
- The absence of fresh water from both the Brazil and Schulpfontein sites.

Of the five proposed sites, development of either the Schulpfontein or the Brazil sitez is assessed as of low risk to freshwater ecosystems. Of the remaining three sites, development of the Duynefontein site would potentially be associated with a moderate risk to existing freshwater ecosystems. Development of Thuyspunt would be associated with unmitigable, permanent loss of relatively unimpacted seepage wetland on the development platforms, although limited development of portions of the site could result in the enforced conservation and protection from human activities of the extensive high dune system and its associated duneslack wetlands of high conservation importance. This site would be a high risk site. Development of Bantamsklip would potentially be associated with positive impacts in terms of affording protection to the upper reaches of the Groot Hagelkraal system, within the context of a managed Nature Reserve. However, presently unresolved issues such as mechanisms for the treatment and disposal of sewage effluent from the site, and the routing of pylons and other services from the site through adjacent areas of potentially high ecological sensitivity lead to an assessment of the site as high risk.

This study raised the following two concerns that do not appear to be addressed in

the present terms of reference of the EIA, but which could have substantial impacts on freshwater ecosystems (and other components of the natural environment). These are:

- The cumulative impact that construction of the proposed Demonstration Pebble Bed Reactor at Koeberg would have, if approved at the same time as a Conventional Nuclear Reactor at this site
- The impact of access roads, pylon lines and other infrastructure that would need to be developed outside of the assessed sites, which could potentially incur ecological impacts that would in their own right result in recommendations for the "no development" option of certain sites, unrelated to environmental conditions on these sites.

2 INTRODUCTION

2.1 Description of Proposed Project

Construction of a conventional Nuclear Power Plant and its associated infrastructure has been proposed at one or more of five potential sites, situated in the Northern, Eastern and Western Cape. The five sites are all technically viable, and consistent with the requirements of the National Nuclear Regulator (NNR). ARCUS GIBB (Pty) Ltd has been appointed by ESKOM to oversee the Environmental Impact Assessment (EIA) phase of the proposed scheme, as well as to co-ordinate the compilation of an Environmental Management Plan.

Freshwater ecosystems were identified amongst other biophysical aspects requiring specialist input into the EIA and to this end, the Freshwater Consulting Group (FCG) was appointed by ARCUS GIBB (Pty) Ltd to provide specialist assessment of the potential impacts to freshwater ecosystems associated with the proposed project.

The following sites are all potentially available for development of Conventional Nuclear Power Plants:

- Thyspunt in the Eastern Cape, near Cape St Francis
- Bantamsklip in the Western Cape, near Pearly Beach
- Duynefontein, adjacent to the existing Koeberg Power Station
- Schulpfontein, in the Northern Cape
- Brazil, also in the Northern Cape, and close to Schulpfontein

This report provides input into the for the specialist Freshwater Ecosystems component **of the Scoping phase** of the EIA. Subsequent phases at which input into Freshwater Ecosystem component of the EIA will be provided include

- the EIA Phase, during which detailed impact assessments of each site will be made
- the Environmental Management Plan (EMP) phase, during which EMPs will be drawn up to cover the construction, operational and decommissioning phases of the proposed developments at each site.

2.2 Terms of Reference

FCG's Terms of Reference for the Scoping Phase of the project, in terms of the July 2007 Revised Proposal, were as follows:

- Broad-scale identification and assessment of sensitivity, ecological function and conservation importance of any freshwater ecosystems on or associated with the five sites selected for screening – formal assessment of these elements will be carried out during subsequent phases of the study
- Qualitative identification of likely impacts to freshwater ecosystems associated with the proposed construction, operation, emergency operation, decommissioning and closure stages of the sites
- Identification of mitigable versus un-mitigable impacts, and red-flagging of ecological issues relating to any site that could result in a "high negative significance" (i.e. "no go") rating at later stages of the EIA process, from a freshwater ecosystems perspective

- Prioritising the five sites, in order of the likely significance of impacts to freshwater ecosystems associated with the proposed activities.

The above terms of reference have been met within the present report framework, as outlined by ARCUS GIBB for all specialist scoping studies.

3 BACKGROUND

3.1 Legislative Framework

This aspect will be addressed by the legal specialist. It is worth noting however that, in the event of any activity that involves infilling, bank alteration, modifications to hydrological regime or other impacts to freshwater ecosystems, authorisation from the Department of Water Affairs and Forestry (DWAF) will be required, in addition to any authorisation required from the Department of Environmental Affairs and Development Planning through the EIA process.

3.2 Assumptions and limitations

- This report provides preliminary input into the assessment of the impacts that may be associated with each of the proposed nuclear station sites. It is based on a review of readily available literature and background information and from information gained, in the case of the Bantamsklip, Thuyspunt and Koeberg sites, from superficial site visits only. Neither Schulpfontein nor Brazil had been visited at the time that this report was written. Thus the conclusions drawn in this report are subject to change, based on the outcomes of future more detailed site-level investigations, and as information from other relevant specialists engaged in this and other studies becomes available.
- At the time of this report, details regarding the footprints of the proposed sites, including footprints for construction lay down, accommodation and infrastructure, as well as of the long-term operational sites themselves, were not available. This report therefore addresses the development footprint impacts at a conceptual and fairly generic level only.
- The full set of published literature, as well as important data such as fine-scale site contours and surface/ groundwater flow linkage information were not yet available at the time of this report – their absence limits the accuracy of these findings.
- Mapping of wetland ecosystems on each site has not yet taken place.
- An integral part of any new power station development is presumably also the associated infrastructure that must be developed, such as roads, pylons, bulk service pipelines and other linkages to the site. Assessment of these routes is not included in the scope of work of the present EIA – yet could conceivably have serious environmental implications. Exclusion of this aspect from the present study limits the efficacy of the overall freshwater ecosystems study to address fully the environmental impacts associated with the proposed development (s).
- The focus of this report is “aquatic ecosystems”. It is noted however that only surface freshwater ecosystems are assessed in this study, and that a more appropriate term for FCG’s specialist input here is that of an assessment of wetland ecosystems, given the recent inclusion of rivers in this broad category, in terms of the National Wetland Classification (Ewart-Smith *et al*. 2006). The wetland definition used in this report is taken directly from that of the National Wetland Classification, which defines wetlands in terms of an adaptation of the Ramsar definition of wetlands, as: “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tides does not exceed ten meters. Wetlands are areas where water is the primary factor controlling the environment and, therefore, wetlands develop in areas where soils are saturated or inundated with water for varying lengths of

time and at different frequencies". Using this definition, the National Wetland Classification further divides wetlands into three system types, namely Marine, Estuarine and Inland systems. This study addresses only **Inland Wetland Systems**. Shallow marine ecosystems are addressed in the specialist Marine Report for this study. No estuarine systems occur within any of the study areas.

4 DESCRIPTION OF THE SITES AND THEIR SURROUNDING ENVIRONMENTS

4.1 Thyspunt

4.1.1 Site context

Thyspunt lies on the Eastern Cape coast, immediately east of Oyster Bay and west of Cape St Francis. The site topography is dominated by west – east running dune systems, comprising relatively low lying (mainly less than 20 mamsl) densely vegetated stable dunes running parallel with and adjacent to the coast and, further north (inland), a line of much taller (over 50 mamsl) largely unvegetated dunes (ESKOM 1994). Invasion by woody alien vegetation is extensive across the site, and particularly in the area between the two dune systems.

4.1.2 Wetland systems on the site as a whole

Wetland ecosystems on the Thyspunt site appear to be divided readily into three main groups, namely:

- Largely unimpacted seasonal dune slack wetlands, which occur within the lower-lying dunefield of the tall dune line. These wetlands are fed by groundwater, and increase in size during winter with distance eastward. The dune / wetland system is referred to in existing assessment reports as the Sand River. Along their northern edge, where alien vegetation increases and farming practices have historically taken place, the wetlands are somewhat more disturbed. These wetlands are believed to be of importance as breeding habitat for several species of frog. They are also probably a regionally rare habitat – dune slack wetlands are not believed to be extensive in this area.
- An expanse of *Prionium serratum* dominated permanent wetland in the north western portion of the site, on the southern edge of the large dune field. In addition to their likely importance as permanently saturated, seasonally inundated marshland habitat, these wetlands are also assumed to be important in terms of their provision of broader wetland "goods and services", such as maintenance of flow into downstream systems, erosion control and water quality amelioration.
- Along the coast itself, numerous freshwater seeps open onto the rocky shores, driven by the contact between the underlying bedrock and the edge of the sandy dunes (ESKOM 1994). These systems are considered of high conservation value and contribute potentially to overall site biodiversity. They may play a role as ecological corridors, facilitating the movement of mammals such as otters and mongooses between the coast and the dune areas. Although fairly common at the level of the site, these are likely to be rare at a regional level, particularly in the relatively unimpacted state in which they occur at Thuyspunt. This relative scarcity reflects the extent of development along the Eastern Cape coastline, resulting in degradation, drainage, canalisation or piping of such wetlands and leading to their transformation into *Typha capensis* -dominated linear channels.

4.1.3 Wetland systems on and near the identified power plant platform

The coastal seeps, described in Section 4.1.2, occur on both potential construction platforms identified on this site. Their present function as habitats would inevitably be compromised by construction of the proposed nuclear sites and, in several cases, would be destroyed altogether.

4.1.4 Sensitivity of identified wetlands on the site

The natural wetlands identified on the site would be sensitive to any activities that resulted in their physical disturbance, drainage, infilling or changes to their natural hydrological regime, including both surface and subsurface and/or groundwater flow linkages. They would also have high sensitivity to changes in water quality, particularly, nutrient enrichment.

Important processes that would need to be maintained are likely to include hydrological connectivity. Any activities that disrupted surface or groundwater linkages in the northern taller dune field area would have serious ecological consequences in terms of wetland function.

4.2 Bantamsklip

4.2.1 Site context

Bantamsklip lies on the western side of the Agulhas Plain, which extends from the Klein River mouth to the Breede River, covering an area of some 270,000 ha. King and Silberbauer (1989) describe the Agulhas Plain as containing the largest and most diverse array of wetlands in the south western Cape with a high likelihood of supporting rare and/or endemic plant and animal species. Wetland systems in the Agulhas Plain area range between saline and fresh systems, and include coastal lakes, floodplains, valley bottom wetlands, seeps and rivers. At a landscape level, they exhibit exceptional diversity, in terms of both habitat type and biota. Conservation of the system in its entirety has been strongly recommended (Jones *et al.* 2002). Rivers on the Agulhas Plain are considered important, both in their own right and due to their contribution to hydrological processes that sustain associated wetland ecosystems (Jones *et al.* 2002). In their classification of wetlands within the Agulhas Plain area, Jones *et al*. identified a total of 72 wetlands, including 37 endorheic (or "inwardly draining") wetlands, 29 palustrine wetlands (these include riverine marshes, floodplains and other riparian areas) and 6 lacustrine wetlands (wetlands with permanent open water habitat). Wetlands occurring on the Bantamsklip site were included in Jones' assessment. However, formal mapping and classification of wetlands has not been carried out at a regional level, and existing spatial data sourced at this stage of the project (e.g. Cole *et al*. 2000) focus on broad scale mapping of terrestrial areas, and are thus of little value in estimating wetland habitat significance.

4.2.2 Overview of wetland systems on the site as a whole

Although several seasonal seepage wetlands are thought to occur on the site south of the R43 Road (King and Silberbauer 1989), the most ecologically important systems occur in the portion of the site to the north, and include the upper reaches of the Koksrivier (a tributary of the Ratelrivier system) to the east, and the Groot Hagelkraal River, to the west.

The Groot Hagelkraal River, upstream of the R43, has been described by Day (2005) as a broad, longitudinal wetland supporting a mixed plant community, dominated on its drier, outer edges by transitional wetland species, including *Chondropetalum tectorum*, *Rhus* spp., and *Metalasia muricata*. These give way to wetter patches comprising a mixed *Psoralea* / *Berzelia* (*Psoralea pinnata, Psoralea afila and Berzelia* spp.) community. The river itself in these reaches comprises a braided stream, edged with a dense overgrowth, including *Zantedeschia aethiopica* (arum

lilies), *Juncus capensis*, and *Ficinia nodosus.* These give way along their margins to the *Berzelia – Psoralea* communities. Large portions of the wetland community appear relatively undisturbed, although the outer edges have been disturbed by impacts such as extensive alien invasion, roads, drainage channels and past agricultural activities.

The Groot Hagelkraal River merges with its westerly tributary, the Klein Hagelkraal River, downstream of the R43 and west of the present study area. Immediately downstream of their confluence, the rivers form a wide, coastal lake, referred to by Jones *et al.* (2002) as the [1]Pearly Beach Marsh and described by King and Silberbauer (1989) as a site of Special Scientific Interest, by virtue of the combination of different wetland types and substrata that characterise it. Euston-Brown (2003) classifies it as of high regional and local importance, from a botanical perspective and Day (2005) describes it similarly in terms of wetland habitat importance. The coastal lake narrows into a wide, slow-flowing river, which opens into a shallow lagoon, on Pearly Beach. Alien vegetation, as well as channelisation of the river downstream of the R43, have resulted in shrinkage and degradation of the Groot Hagelkraal riverine wetlands in these reaches, and a reduction in the species diversity that occurs upstream (Day 2005). Nevertheless, Day (2005) considered these wetlands, and in particular, the less-impacted Pearly Beach Marsh / coastal lake and lagoon to have high habitat conservation value.

The Koksrivier flows off the north eastern portion of the site above the R43, and its catchment within the study area includes broad hillside seepage wetlands, occasional seasonally inundated springs or pans and, along the river channel itself, a dense band of *Prionium serratum (*Palmiet) vegetation. The river on the site is believed to be relatively unimpacted and of high conservation importance. De Villiers (1989) noted the importance of the Ratels River wetlands downstream as habitat for two red-data frog species, namely *Microbatrachella capensis* (micro frog) and *Xenopus gilli* (Cape platanna).

4.2.3 Wetland systems on and near the identified power plant platform

No wetlands were identified within the proposed power plant platforms.

4.2.4 Sensitivity of identified wetlands on the site

The natural wetlands identified on the site would be sensitive to any activities that resulted in their physical disturbance, drainage, infilling or changes to their natural hydrological regime, including both surface and subsurface and/or groundwater flow linkages, and changes in water quality – particularly, nutrient enrichment (Day 2005). The wetlands would also be sensitive to any activities that increased their vulnerability to invasion by alien plants. Important processes that would need to be maintained are likely to include hydrological connectivity and the maintenance of riverine and wetland corridors, between source areas and the sea.

[1] note that the Pearly Beach Marsh lies outside of the Bantamsklip site

4.2 Duynefontein

4.3.1 Site context

The Duynefontein Site (also referred to in previous reports as the Koeberg Site) lies some 8km north of Melkbosstrand, on the sandy coastal plain of the West Coast. Most of the site has been classified as comprising Cape Flats Dune Strandveld vegetation, with Atlantis Sand Fynbos occurring in the southern and eastern portions of the site (see botanical report). No rivers flow through the site, and the closest drainage line of significance is the Sout River and its largest tributary, the Donkergatspruit, which enter the sea at Melkbosstrand. Indeed, the southwestern portion of the site, south of the existing Koeberg power plant, is the only portion of the Duynefontein Site where the terrain is low-lying enough to support significant areas of natural wetland habitat. Here, the slack areas between a series of low-lying east-west running dunes give rise to a mosaic system of alkaline dune slack wetlands (FCG unpublished data).

4.3.2 Overview of wetland systems on the site as a whole

The wetlands are fed primarily by a seasonally fluctuating water table, forming pools of shallow, brackish water during winter, which provide breeding habitat for frogs as well as numerous aquatic and semi-aquatic invertebrates including crustacean fauna typical of highly seasonal wetland habitat. These pools dry out in summer as the water table recedes. Wet season salinities in the wetlands are probably elevated, as a result of marine influences such as sea mists and off-shore winds. The wetlands are considered of high local, regional and international importance, although their similarity to other wetlands north of the site has not yet been established.

The northern sections of the wetlands increasingly have shorter hydroperiods represented by seasonally to ephemerally saturated wetland seeps, dominated by stands of *Ficinia nodosus*. This species is indicative of the area transitional between wetland and terrestrial habitat. The northern area has been disturbed by past activities on the site – including serving as a lay-down area during construction of the existing power plant – and the wetland seepage line is increasingly (and to some extent, naturally) fragmented with distance north. Artificial excavations in this area have given rise to the formation of deep, *Typha capensis* lined ponds, which provide locally rare breeding habitat to birds such as Red Bishops and Cape Weavers, but which have a generally low conservation status.

Virtually no other natural freshwater systems are believed to occur on the rest of the Koeberg Site. In the north, a series of coastal infiltration ponds have been excavated between the dunes. These are fed by treated industrial effluent, and untreated stormwater runoff from the Atlantis industrial area (Day and Ewart-Smith 2005). A suspected link between the effluent pond closest to the sea and an observed increase in seepage from, and subsequent deterioration in, the limestone cliffs along a section of coastal shoreline nearby, resulted in reduced usage of this pond over the past 10 years (Day and Ewart-Smith 2005).

The ponds themselves are highly artificial habitats, comprising deep, permanent, open-water bodies, vegetated by species that thrive under conditions of nutrient enrichment. The deeper ponds are lined by *Typha capensis*. Floating invasive aquatic weeds (e.g. *Lemna gibba*) occur ion the pond surfaces, and the ponds are prone to occasional algal blooms, as well as outbreaks of so-called “blue-green

algae" blooms.

The infiltration ponds provide permanent habitat to a variety of swimming waterfowl, although the scarcity of shallow water habitat make them of limited value to wading birds. Fish have been introduced to the ponds, primarily to provide an early warning of water quality problems (Day and Ewart-Smith 2005). Overall, the ponds are unnatural water features, and provide a low quality, but locally rare, permanent freshwater habitat, artificially contributing to plant and animal diversity in the area. They play an important role in terms of providing a hydraulic barrier for the protection of the greater Atlantis Aquifer from seawater intrusion.

4.3.3 Sensitivity of identified wetlands on the site

The natural wetlands identified on the site would be sensitive to any activities that resulted in their physical disturbance, drainage, infilling or changes to their natural hydrological regime, as well as any activities that increased their susceptibility to invasion by alien plants.

4.3.4 Wetland systems on and near the identified power plant platform

No wetlands occur on or in the immediate vicinity of the approximate extent of the proposed building platform, which comprises a previously levelled disturbed environment.

4.4 Brazil and Schulpfontein

4.4.1 Site context

These sites are both located in the Northern Cape Province, on the Namaqualand coast. The arid climate (100-300mm rainfall per annum) means that sources of natural surface water are scarce and no wetland habitats of any kind are believed to occur on either site. Note however that ground truthing of the availability of freshwater systems on the sites had not been carried out prior to submission of this report.

Wetland systems that would be typical of the area would be characteristically ephemeral to strongly seasonal, with high evaporation rates often giving rise to brackish to saline water quality. Such wetlands occur in the form of shallow, usually perched pans or pools, or on concavities on rocks. Aquatic fauna would be dominated by species with adaptations that allow them to survive long periods of drought and sometimes heat, and to respond rapidly to often brief periods of inundation. If such systems do exist on these sites, they would have a high conservation importance, as rare features of the landscape and in providing habitat for a variety of local and migratory fauna.

4.4.2 Wetland systems on and near the identified power plant platforms

No wetland systems are currently believed to be on or near to the proposed power plant platforms.

5 IMPACTS AND MITIGATION MEASURES

5.1 Project impacts on freshwater ecosystems and possible mitigation measures

Note that this section is intended to provide only preliminary input into the assessment of potential impacts associated with the proposed power plants – subsequent phases of the project will be better informed regarding footprints of the plants, necessary infrastructure, construction programmes and operational phase impacts associated with nuclear power plants in both normal and emergency situations.

It is also again stressed that significant impacts might be associated with the routing of roads, pylons and services such as water and sewage through important wetland ecosystems outside of the assessed sites. Assessment of these issues should ideally be included in the overall Nuclear EIA.

5.1.1 Negative impacts of the project on freshwater systems

The following **negative** impacts have been redflagged as of potential significance to freshwater ecosystems:

- Infilling or other means of destruction of wetlands to accommodate building platforms, infrastructure or lay down areas during construction. It is noted that:
    - this impact would definitely be associated with the Thuyspunt site – the extent to which seepage wetlands occur across both building platforms has however not yet been quantified
    - the position or extent of lay down areas is not yet known
    - the extent and possible locations of infrastructure such as offices, laboratories etc is not yet known

  Recommended mitigation measures
    - No mitigation against infilling of seepage wetlands on Thuyspunt would be possible; should infilling of wetlands on any other site be required, no mitigation against this impact would be possible either
    - The location of infrastructure and lay down areas would need to avoid identified wetland areas – establishment of setback or buffer areas would in all cases be necessary between any wetland and a development-related activity or structure.

- Physical disturbance to wetlands during construction or subsequent phases
    - All sites on which wetlands occur would be potentially vulnerable to this impact, which could lead to: hydrological change, particularly in the creation of preferential runoff pathways and erosion that may affect the whole wetland extent; changes in permeability (e.g. as a result of compaction); loss of rare species; increase in invasion by alien and other invasive plant species.

  Recommended mitigation measures
    - The site layout should establish sufficient buffer areas between zones of activity / impact and identified wetland areas to prevent this impact. Wetland areas should be demarcated, and appropriate buffer areas assigned to each during layout planning.

- Strong construction phase controls and on-site supervision by an Environmental Control Officer would be necessary, and should be stipulated within an Environmental Management Plan.

- Drainage of wetlands during construction-associated dewatering of excavations
  - Depending on the extent of impact, this could result in temporary or permanent impacts to wetland systems: geohydrological input is required on this aspect

  Recommended mitigation measures

  Geohydrological input is still required on this aspect – and mitigation measures are likely to be highly site specific.

- Disruption of surface/ groundwater interactions by:
  - laying of roads, pipelines / cables across wetland or groundwater areas that would be sensitive to this impact: the dune slack wetlands of Thuyspunt and potentially Koeberg / Duynefontein are probably the most vulnerable to this impact, although the Bantamsklip wetlands could be disrupted in the (unlikely) event of construction in the northern, upper portion of the site - geohydrological input is required on this aspect
  - destruction of dune areas that may play a role in conducting groundwater and surface runoff / surface or subsurface seepage water to surface ecosystems
  - surface or groundwater abstraction: groundwater abstraction has been proposed for Thuyspunt (ESKOM 1994) - geohydrological input is required on this aspect

  Recommended mitigation measures

  - no abstraction should take place from aquifers with direct links to (surface) freshwater ecosystems
  - no abstraction should take place from surface water systems without detailed investigations to show that it has negligible impacts and detailed monitoring of potential impacts during operational phases
  - roads, cables and pipelines should all avoid passing through areas identified as important hydrological corridors
  - no roads, pipelines, cable routes or other structures should be passed through wetland areas.

- Disposal of sewage effluent from residential areas developed to house construction or operational phase personnel
  - Where development of the proposed power plants would result in the need for substantially larger volumes of sewage to be treated than carried out at present, there may be substantial implications for freshwater ecosystems. These would include nutrient enrichment and alteration in hydrological regime / hydroperiod, both of which can have profound effects on ecosystem character.
  - These impacts would be most likely to occur where existing residential developments are small – that is, all sites except for Duynefontein. Sites that are known to be associated with river systems that would be highly sensitive to receipt of treated sewage effluent include Bantamsklip – the freshwater ecosystem EIA for a proposed upgrade to the existing WWTW at Pearly Beach recommended that this should be treated as a “no go”

option, in view of the likely impact to the Pearly Beach Marsh downstream. Disposal of effluent by irrigation to groundwater is not an option at this site either (Day 2005).

Recommended mitigation measures

- The quality and quantity of any treated effluent should be such that it does not impose risks of degradation to important wetland (or other) ecosystems. **This aspect would need to be explored further in subsequent phases of this project, since, at least in the case of Bantamsklip, it constitutes a sufficiently significant impact in its own right to warrant a "high significance/ no go" rating for the proposed development at this site.**

5.1.2 Positive impacts of the project on freshwater systems

The following **positive** impacts have been redflagged as of potential significance to freshwater ecosystems:

- Active management of invasive alien vegetation
  - The operational phase of the existing nuclear plant at the Duynefontein / Koeberg site provides an opportunity to evaluate the extent to which the site affords protection of natural areas and the extent to which management within a Nature Reserve context has been successful from an ecological perspective. In the case of Koeberg, management of the Nature Reserve has centred on removal of alien vegetation, and large portions of the site have little or no invasion by alien vegetation. Alien plant invasion is one of the greatest threats affecting wetland habitat integrity at both Bantamsklip and Thuyspunt. At Thuyspunt, wetlands in the northern portion of the site, north of the dune slack area, are most affected by alien invasion, although indirect impacts such as reduction in runoff associated with high water use by woody alien plants might also affect certain wetlands. Inclusion of important wetland areas in protected, largely inaccessible nature reserves within the broader development sites would be a positive direct impact associated with the proposed project at Bantamsklip and Thuyspunt. However, it should also be recognised that clearing of listed aliens is the legal duty of all landowners, in terms of the Conservation of Agricultural Resources Act (CARA) (Act No 43 of 1983 (as amended)). In this respect, management of alien vegetation should theoretically take place even without the development of one or more Nuclear Power Plants at these sites.

- Protection of ecologically meaningful extents of natural areas from piecemeal development and edge impacts:
  - Inclusion of the high dune system at Thuyspunt in a managed Nature Reserve would enable permanent protection of both seasonal wetlands, their terrestrial interfaces and groundwater linkages at a scale that might not be achievable within alternative development scenarios.

5.2 Environmental constraints to development of the Nuclear Power Plants

Effective management of the environment to ensure long-term sustainability of natural ecosystems on the sites poses constraints to the extent and/or economic cost of development. The following issues have been identified as potentially limiting or at least challenging the project development:

- Development of mechanisms to treat construction and operational phase sewage to an ecologically acceptable water quality standard and dispose of it without incurring adverse ecological effects: in the case of Bantamsklip, this is possibly one of the most serious challenge posed to the project in terms of management of freshwater ecosystem issues
- The locations of wetland corridors both within and outside of the proposed sites pose challenges to the routing of pylons, pipelines and access roads from the sites to other centres, without imposing negative impacts on these systems.
- The absence of fresh water from both the Brazil and Schulpfontein sites means that alternative options for domestic water supply, and their potential environmental impacts, need to be investigated.

6 SITE SENSITIVITY ANALYSIS

6.1 Approach to assessing Site Sensitivity

Site sensitivity analyses have been based, at this stage in the project assessment, on a combination of the assumed **importance** of identified wetland systems, and their **sensitivity** to particular impacts likely to be associated with the proposed development, outlined in Section 5.

6.2 Formal assignment of ecological importance

DWAF (1999) defines Ecological Importance as "an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales" (see Box 1), and Ecological Sensitivity as "the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred".

A number of protocols have been developed in South Africa for the assessment of wetland ecological importance. These include:

- DWAF's (1999) protocol for assessing wetland Ecological Importance and Sensitivity (EIS), itself an adaptation of a methodology developed by Kleynhans (1996).
- Southern Waters' (2000) refinement of the EIS protocol, to include an assessment of socio-cultural and functional attributes.

Box 1 Why are wetlands important?

Wetlands are internationally recognised as important natural ecosystems (e.g. Cowan 1995), which, depending on the characteristics of each wetland type, may perform a number of the following valuable ecological and other functions, including (Davies and Day 1998):

- provision of habitat to wetland-associated animals and plants, many of which rely exclusively on these areas for breeding, feeding or nursery areas (Cowan 1995).
- provision of corridors for movement between terrestrial natural areas, or along river systems
- contributing to perenniality of stream systems, through retention and slow release of waters during lowflow periods
- flood attenuation – effected by retention of flood waters in wetland soils, and reduction of flood velocities through dissipation of flows through wide, vegetated areas
- improving water quality, through uptake and absorption of nutrients and other contaminants often found in surface runoff
- trapping sediment and reducing erosion of stream channels.

Despite the acknowledged ecological, economic and educational value of wetlands, it has been estimated that over half of South Africa's wetlands have already been destroyed and lost, while those that remain are among South Africa's most threatened natural areas (Noble & Hemens 1978; Begg 1986). South Africa is a signatory to the Ramsar Convention, an international treaty aimed at the conservation of wetland habitats (Cowan 1995). This convention binds members to a set of criteria aimed at the conservation of wetland ecosystems. These criteria include: stemming the loss of wetlands, promoting the wise use of all wetland areas and promoting the special protection of listed wetlands.

The above protocols are all based on assessing ecological importance in terms of the presence of *inter alia*, rare species, biodiversity, bird migration route nodes and sensitivity to water quality changes. One of the limitations of such an approach is that fairly detailed information is required on the character, flora and fauna, as well as seasonal variability and water quality of the system, to fulfil the requirements of the

assessment. At the present phase of this component of the Nuclear 1 EIA process, such data are simply not available for the systems in question.

In recognition of such problems, Ewart-Smith and Ractliffe (2003) adapted all of the above methodologies for use in assessing wetlands where data are limited. Box 2 outlines their approach, which has been selected for use in the present phase of this project. The approach may be refined or replaced with more appropriate assessment tools, in subsequent, more data-rich phases of the project.

Box 2 Approach to assessment of wetland importance, as developed by Ewart-Smith and Ractliffe (2002)

The assignment of conservation importance had as a starting point the recognition that almost any wetland habitat, degraded or pristine, is conservation-worthy because of its contribution to biotic diversity, its function, or the limited size and current rate of loss or degradation of wetlands of all types.

The following criteria are used to assign low, moderate or high conservation importance to wetlands identified in the study area (note that the overall importance rating is the highest rating achieved for any criterion):

1 Low conservation importance:

- does not provide ecologically or functionally significant wetland habitat, because of extremely small size or degree of degradation, and/or
- of extremely limited importance as a corridor between systems that are themselves of low conservation importance.

2 Moderate conservation importance:

- provides ecologically significant wetland habitat (e.g. locally important wetland habitat types), and/or
- fulfils some wetland functional roles within the catchment, and/or
- acts as a corridor for fauna and/or flora between other wetlands or ecologically important habitat types, and/or
- supports (or is likely to support) fauna or flora that are characteristic of the region and/or
- provides habitat to indigenous flora and fauna, and/or
- is a degraded but threatened habitat type (e.g. seasonal wetlands), and/or is degraded but has a high potential for rehabilitation, and/or
- functions as a buffer area between terrestrial systems and more ecologically important wetland systems, and/or
- is upstream of systems that are of high conservation importance.

3 High conservation importance:

- supports a high diversity of indigenous wetland species, and/or
- supports, or is likely to support, red data species;
- supports relatively undisturbed wetland communities, and/or forms an integral part of the habitat mosaic within a landscape, and/or
- is representative of a regionally threatened / restricted habitat type, and/or
- has a high functional importance (e.g. nutrient filtration; flood attenuation) in the catchment, and/or
- is of a significant size (and therefore provide significant wetland habitat, albeit degraded or of low diversity).

Based on the methodology outlined in Box 2, and with the caveat that these assessments have been carried out with only limited information regarding each site, the wetlands identified at this stage of EIA process have been assigned the following levels of ecological importance:

- Thuyspunt site
    - seasonal dune slack wetlands - high conservation importance
    - *Prionium serratum* permanent wetland - high conservation importance
    - freshwater seeps along the rocky shore - moderate conservation importance
- Bantamsklip site
    - Groot Hagelkraal River - high conservation importance
    - Koksrivier *Prionium serratum* wetland - high conservation importance
    - Seasonal wetlands associated with Groot Hagelkraal River and Koksrivier - high conservation importance
- Duynefontein site
    - Alkaline duneslack wetland mosaic - high conservation importance
    - Artificial *Typha capensis* ponds in southern site – low conservation importance
    - Artificial recharge ponds in northern site – moderate conservation importance (based on function as an hydraulic barrier)
- Brazil site
    - No wetlands identified
- Schulpfontein site
    - No wetlands identified

6.3 Criteria for site sensitivity analysis

Assessment of site sensitivity in terms of freshwater ecosystems is based on:

- the number, extent and conservation importance of wetlands on the site
- the spatial arrangement of wetlands, including their interconnectedness and their dependence on adjacent ecosystems
- the dependence of ecosystems (including wetlands) outside of the site on natural functioning of wetlands on the site (e.g. wetlands can play a role in supporting pollinators of terrestrial areas during parts of their life cycles)

6.4 Preliminary site sensitivity analysis

Based on the criteria outlined above, the following proposed sites would be considered highly sensitive in terms of wetland ecosystems:

- Thuyspunt: the site includes extensive wetlands of high conservation importance;
- Bantamsklip: the site includes extensive wetlands of high conservation importance, which feed into important downstream systems, such as Pearly Beach Marsh and the Ratels River wetlands
- Duynefontein: the site includes wetlands of high conservation importance.

The following proposed sites would be considered to have low sensitivity in terms of wetland ecosystems:

- Brazil
- Schulpfontein

- based on the likely absence of wetlands from these two sites.

Note that rating of site sensitivity does not imply that a site is not suitable for the development of a Conventional Nuclear Power Plant – it merely indicates that there are significant issues associated with freshwater ecosystems which would need to be accommodated in a design proposal. Future phases of this project EIA will provide clarity on the degree to which these systems can be accommodated within a nuclear development framework at each of the proposed development sites.

7 ASSESSMENT OF ECOLOGICAL RISK AT A SITE LEVEL

This section addresses the risk posed by development of each site, in terms of its impact to freshwater ecosystems. This analysis forms an integral part of rating of sites in terms of their development impacts.

Sites associated with a high risk of negative impacts to wetland ecosystems are assumed to be those where:

- the site supports wetland ecosystems that are considered to have high or medium conservation importance and that would require particular attention to be paid in terms of project design, in construction, normal operation, emergency operation or decommissioning stages, to avoid impacting on either the wetlands themselves, OR their linkages and interactions with other ecosystems OR their ability to perform ecologically important identified processes AND where
- the preferred location / only possible location of the development footprint lies in or near to wetlands, or is only accessible through wetlands or their supporting habitats / zones
- infrastructural development associated with the project (e.g. roads, pylons) could impact on wetlands
- mitigation of impacts to wetland ecosystems is not possible or only partial mitigation is likely.

Of the five proposed sites, development of either the **Schulpfontein** or the **Brazil** site appears unlikely to have implications for freshwater ecosystems, and these sites should, at least at this stage, be evaluated in terms of other environmental criteria. These sites are **low risk** sites.

Of the three remaining sites, development of the **Koeberg / Duynefontein** site would potentially be associated with least risk to existing freshwater ecosystems, given that ancillary impacts, such as pylon lines, water and sewage are unlikely to be of significance to freshwater ecosystems, as these services are already largely in place. Also, the important and highly sensitive duneslack wetlands that occur on the site do not lie on the proposed work platform. These do, however, lie in close proximity to existing disturbance platforms south of the proposed site, and would be vulnerable to disturbance if these areas were utilised. This site would be a **moderate risk** site.

Development of **Thuyspunt** would be associated with unmitigable, permanent loss of relatively unimpacted seepage wetland on the development platforms. At the same time, though, development of limited portions of the site for infrastructure associated with the power plant could result in the enforced conservation and protection from human activities of the extensive high dune system and its associated duneslack wetlands of high conservation importance. This aspect needs to be weighed carefully against a “no development” scenario, in which these systems, even if themselves left undeveloped, would almost inevitably be impacted by high levels of human activity and coastal development. This site would be a **high risk** site.

As in the case of Thuyspunt, development of **Bantamsklip** as a Nuclear Power Station would potentially be associated with positive impacts in terms of affording protection to the upper reaches of the Groot Hagelkraal system, within the context of a managed Nature Reserve and assuming that infrastructure associated with the site

avoids sensitive ecological habitats and corridors. However, presently unresolved issues such as mechanisms for the treatment and disposal of sewage effluent from the site, and the routing of pylons and other services from the site through adjacent areas of potentially high ecological sensitivity force a conservative response to this development site, and it is therefore assessed as “least desirable” in terms of the risk of incurring significant impacts to freshwater ecosystems. This site would be a **high risk** site.

8 RECOMMENDATIONS

The Scoping Phase, presented in this report in terms of freshwater ecosystems, has highlighted the following information gaps that need clarity during the next assessment phase, namely:

- The need for close liaison between groundwater, hydrological and freshwater ecosystem specialists in predicting ecological impacts and recommending appropriate mitigation measures
- The nature and extent of surface / groundwater interactions – this information is required prior to completion of the Baseline Assessment
- The need for detailed technical information, informing specialists of:
    - constraints to the flexibility of the development in terms of alternative orientation/ location of structures and services on the site
    - the extent of each proposed development platform
    - the extent of new infrastructure that will need to be developed within each site, and the flexibility with which different components may be located around the site
    - the need for development of services such as sewage treatment, and the extent to which this may impact on natural ecosystems
- The potential direct impacts of the power plants on freshwater ecosystems during emergency operations
- The importance of detailed mapping of wetland systems and their links to hydrological and geohydrological processes, and to other natural habitats, if the potential impacts associated with the proposed developments are to be assessed accurately
- The need for detailed biodiversity and physico-chemical data to inform assessments of wetland importance, function and sensitivity.

Finally, the following two concerns are raised, as issues that do not appear to be addressed in the present terms of reference of the EIA, but which could have substantial impacts on freshwater ecosystems (and other components of the natural environment). These are:

- the cumulative impact that construction of the proposed Demonstration Pebble Bed Reactor at Koeberg would have, if approved at the same time as a Conventional Nuclear Reactor at this site – potential issues include the impact of simultaneous construction programmes on the availability of suitable lay down areas and infrastructure, and the resulting constraints on choice of least-damaging lay down areas
- the impact of access roads, pylon lines and other infrastructure that would need to be developed outside of the assessed sites, which could potentially incur ecological impacts that would in their own right result in recommendations for the “no development” option as the preferred alternative for a site, even where the present process does not red flag any significant development constraints.

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