Witberg Wind Energy Facility and associated infrastructure, Western Cape Province

Environmental Management Programme – Revision 1

April 2019

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PROJECT DETAILS

Title	:	Witberg Wind Energy Facility and associated infrastructure, Western Cape Province: Environmental Management Programme – Revision 1
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Client	:	Witberg Wind Power (Pty) Ltd
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1 ENVIRONMENTAL MANAGEMENT PROGRAMME

1.1 Introduction

This Environmental Management Programme (EMPr) has been compiled for the Witberg Wind Energy Facility (WEF) and associated infrastructure proposed by Witberg Wind Power (Pty) Ltd. The proposed Witberg Wind Energy Facility (WEF) is located on a site ~9km west of Matjiesfontein in the Laingsburg Local Municipality, which falls within the jurisdiction of the Central Karoo District Municipality in the Western Cape Province. This development is to be constructed within the project site which comprises the following farm portions:

» Remainder of the Farm Jantjesfontein 164;
» Remainder of the Farm Besten Weg 150;
» Remainder of Portion 1 of the Farm Besten Weg 150;
» Remainder of the Farm Tweedside 151;
» Remainder of the Farm Elandskrag 269; and
» Portion 1 of the Farm Elandskrag 269.

From the specialist investigations undertaken within the Environmental Impact Assessment (EIA) process for the wind energy facility (Final Environmental Impact Report (FEIR), dated July 2011), no environmental fatal flaws were identified. However, several 'no go' areas were identified on the site including areas of sensitivity in respect of birds, fauna and flora, and visual. In addition, the following environmental impacts were identified:

» Potential impacts on birds;
» Potential impacts on bats;
» Potential ecological impacts;
» Potential impacts on heritage;
» Potential noise impacts;
» Areas of visual impact; and
» Potential socio-economic impacts.

Witberg Wind Power (Pty) Ltd received an EA for the construction of Witberg Wind Energy Facility and associated infrastructure in the Western Cape Province (DEA ref: 12/12/20/1966) on 13 October 2011. An appeal decision (Reference: LSA 105-439), dated 13 August 2013, was subsequently issued by the Minister of Environmental Affairs reducing the number of originally authorised wind turbines from 70 to 27 turbines, along with revised turbine specifications, as guided by the inputs of the Independent Bird Specialist (Dr. Steve Percival – Shoney Renewables Consulting), who conducted a Collision Risk Modelling Report, dated 2013.

1.2 Key conclusions and recommendations of the EIA

From the specialist investigations undertaken as part of the original Environmental Impact Assessment (EIA) for the wind energy facility, it was concluded that the majority of impacts were of minor to moderate significance with the implementation of appropriate mitigation measures.

Areas of sensitivity identified during the EIA process include:

- Birds:
  - This is a medium-sized proposed Wind Farm development, for a site with a moderate to high degree of sensitivity with respect to avifauna. There are no regionally or nationally critical populations of impact susceptible species within or close to the development area, and the proposed site does not impinge on any known major avian fly-ways or migration routes. However, it does seriously impinge on an important landscape feature – the Witberg ridge, and may have a significant negative effect on the avifauna of this ridge (including breeding pairs of large eagles and concentrations of localised endemic species) in both the construction and operational phases of the development.
- Bats:
  - The higher lying areas on top of the Witberg where the turbines are proposed vary greatly from the lower lying flat areas and the mountain footslopes, where more favourable bat foraging habitat is provided. It has been noted however, that bats may roost in the rocky higher lying areas and move down to the mountain footslopes and lower valley to forage on a nightly basis. Potential roosts on the proposed windfarm site are mainly rock crevices. Additionally, bats may pass over the mountain on a nightly basis to reach foraging habitat on the other side, moving between the mountain peaks.
- Ecology:
  - **Flora** – The vegetation of the project site includes the Matjiesfontein Quartzite Fynbos and the Matjiesfontein Shale Renosterveld. The Matjiesfontein Quartzite Fynbos should be viewed as a generally more sensitive vegetation type than the Matjiesfontein Shale Renosterveld.
    - Portions of the site fall within a Critical Biodiversity Area (CBA), as defined in the Central Karoo Biodiversity Assessment (Skownow *et al*., 2009), located in the south eastern portion and eastern side of the site.
    - In terms of the listed plant species which occur in the area, a number of critically endangered species occur within the general area. These include *Gasteria disticha*, *Gibbaeum nebrownii* and *Protea convexa*. The first two species are associated with more arid environments and are not likely to occur within the area earmarked for development. *Protea convexa* occurs on north-facing slopes within the Matjiesfontein Quartzite Fynbos of the area. Several other listed species such as *Leucadendron teretifolium* and *Leucadendron cadens* were common at the site in areas earmarked for development. *Leucadendron teretifolium* is listed as Near Threatened while *Leucadendron cadens* is listed as Rare and is a narrow Witteberg endemic. Both of these species were very common along the tops of the ridges, and *Leucadendron teretifolium* formed dense populations in some places. Given the abundance and distribution of these species relative to the proposed footprint of the wind farm, it is inevitable that some individuals of these species would be lost should the development proceed. As both of these species are locally abundant, the loss of some individuals should not impact the viability of the local populations.
  - **Fauna** – At least 50 mammal species potentially occur at the site. The diversity of habitats available at the site, which includes rocky uplands, densely vegetated kloofs and riparian areas, as well as open plains and low shrublands, a high proportion of the mammal species which potentially occur in the region are likely to be present at the site.
    - The only mammal species of conservation concern which could be perceived to occur at the site is the Riverine Rabbit, *Bunolagus monticularis*, which is listed as Critically Endangered (IUCN 2010) and is regarded as the most threatened mammal in South

Africa. It is highly unlikely the Riverine Rabbit occurs on the Witberg site where the turbines are located due to the fact that it has not been recorded in such high rocky ridges, and is generally found in the lower lying valleys and riverine corridors. Additional studies to ascertain the presence of the Riverine Rabbit at the site were not warranted given the marginal nature of the habitat as well as the fact that the development is not likely to significantly impinge on any potential habitat which may occur at the site.

- Approximately 47 reptile species potentially occur at the site, comprising 5 chelonians, 15 snakes, 18 lizards or skinks, 2 chameleons and 7 geckos. Only two of these are listed by the IUCN, namely the Namaqua Plated Lizard which is listed as Near Threatened and Fisk's House Snake which is listed as Vulnerable. Both of these species are widely distributed and the site is not known to be an important area for either of them.
- The semi-arid nature of the site and the paucity of above-ground water render the area generally unfavourable for amphibians.
- Only eight amphibians are likely to occur at the site. There are no threatened amphibian species known to occur on the site, and that the site is generally unfavourable for amphibian habitation (apart from seasonally wet valleys between ridges).

» Heritage (Including Palaeontology):
  - Aspects of the Witberg site and surrounds that may be of heritage interest include numerous trace fossils in the Witpoort Formation sandstones, historic dry-packed stone walls, Stone Age artefacts, stone ruins and cairn, heritage cement and stone dams, two historic farm complexes (with four graves found in one of the complexes, and a Victorian house and stone barns, with a cement dam dating back to at least 1944 found in the other complex) and visual cultural landscape aspects associated with the sense of place of the area.
  - **Palaeontology** - All the geological horizons in the Study Area are potentially fossiliferous. Consequently, all excavations, whether for road cuttings or foundations, may reveal fresh fossiliferous rock of as-yet unknown significance. The greatest likelihood of new discoveries is in the Kweekvlei, Floriskraal, and Waaipoort Formations of the Witteberg Group, where the significance of any discoveries would be major. Note that if proper palaeontological surveys are conducted during excavation the potential finding of palaeontological resources for furthering scientific knowledge could have a positive impact.

» Noise:
  - The ambient noise level of 33 dBA[1] recorded at the Witberg site is considered typical for the area. The predicted LAeq due to the wind turbines would be less than 20 dBA at and beyond the site boundaries except to the west of land parcel Elandskrag RE/269 where the LAeq[2] would be between 25 dBA and 30 dBA. All levels would be less than the typical LReq.n[3] of 35 dBA and there would therefore be no noise impact on land beyond the wind farm site boundaries.
  - In terms of the Western Cape NCR the predicted noise levels would be less than the average measured daytime residual level of 33 dBA. The noise levels would not be considered to be a disturbing noise and no noise mitigation would be required.

» Visual:
  - The proposed wind farm on the mountain ridgelines would have a low to medium visibility (the latter for a distance of 10 to 12 km), and highly visible for a section of 6km from the N1 National

(1) [1] A-weighted decibels, abbreviated **dBA,** are an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced.
(2) [2] **LAeq** is the sound level in decibels equivalent to the total A-weighted sound energy measured over a stated period of time.
(3) [3] **LReq.n** is the sound rating level for night time.

Road. From the main rail line, the wind farm would be medium o highly visible for a 12to 15 km stretch, and marginally visible from Matjiesfontein, which is a tourist destination. The general area is otherwise sparsely populated, with only a few scattered farmsteads.

- The physical presence of the proposed Wind Farm may alter the visual character of the landscape, as the proposed infrastructure, particularly the turbines, is in contrast to the rural surrounding landscape.
- From the view shed analysis of the Final Layout (Alternative 3 – not the currently proposed layout) it can be determined that the Wind Farm would be visible from approximately 75% of the area within a 10 km radius because of the view-shadow effect of the topography.
- The Witberg Wind Farm would be visible to motorists travelling on all of the above-mentioned roadways to varying degrees (medium to high visibility).
- The Wind farm would have a high visibility from the secondary roads located on the site.
- The Wind Farm would be visible from a10 km distance by the rail line, with visibility ranging from low to high, as the rail line passes close and through a portion of the site.

» Socio-economic:
- There are no social recommendations for micro-siting of the wind turbines or associated infrastructure.

1.3 Amendment of the EA Details

In terms of the appeal decision dated 13 August 2013 (Reference: LSA 105-439), the reduction of wind turbines from 70 to 27 turbines along with revised turbine specifications was approved due to avifaunal sensitivities. No-go areas were therefore identified and adhered to at the time for the revised wind turbine layout (Layout Revision 7). Subsequently, an amendment application was undertaken to take into a consideration amendment to the authorised turbine specifications as follows:

» Range of Hub height: from 92m to a range from 92m to up to 120m;
» Range of Rotor diameter: from 116m to a range from 116m to up to 136m; and
» Range of Wind turbine capacity per wind turbine: from 3MW to a range from 3MW to up to 5MW.

In addition, an amendment to the wind farm layout was required to avoid additional sensitive areas identified in the amendment process, and to optimise the layout. Therefore, the number of wind turbines have been reduced from 27 wind turbines to 25 wind turbines, and the wind turbines and associated infrastructure re-positioned within the originally assessed site. The current proposed layout is shown in **Figure 1.1. Figure 1.2** shows the layout for the wind farm over-laid with the identified sensitivity areas.

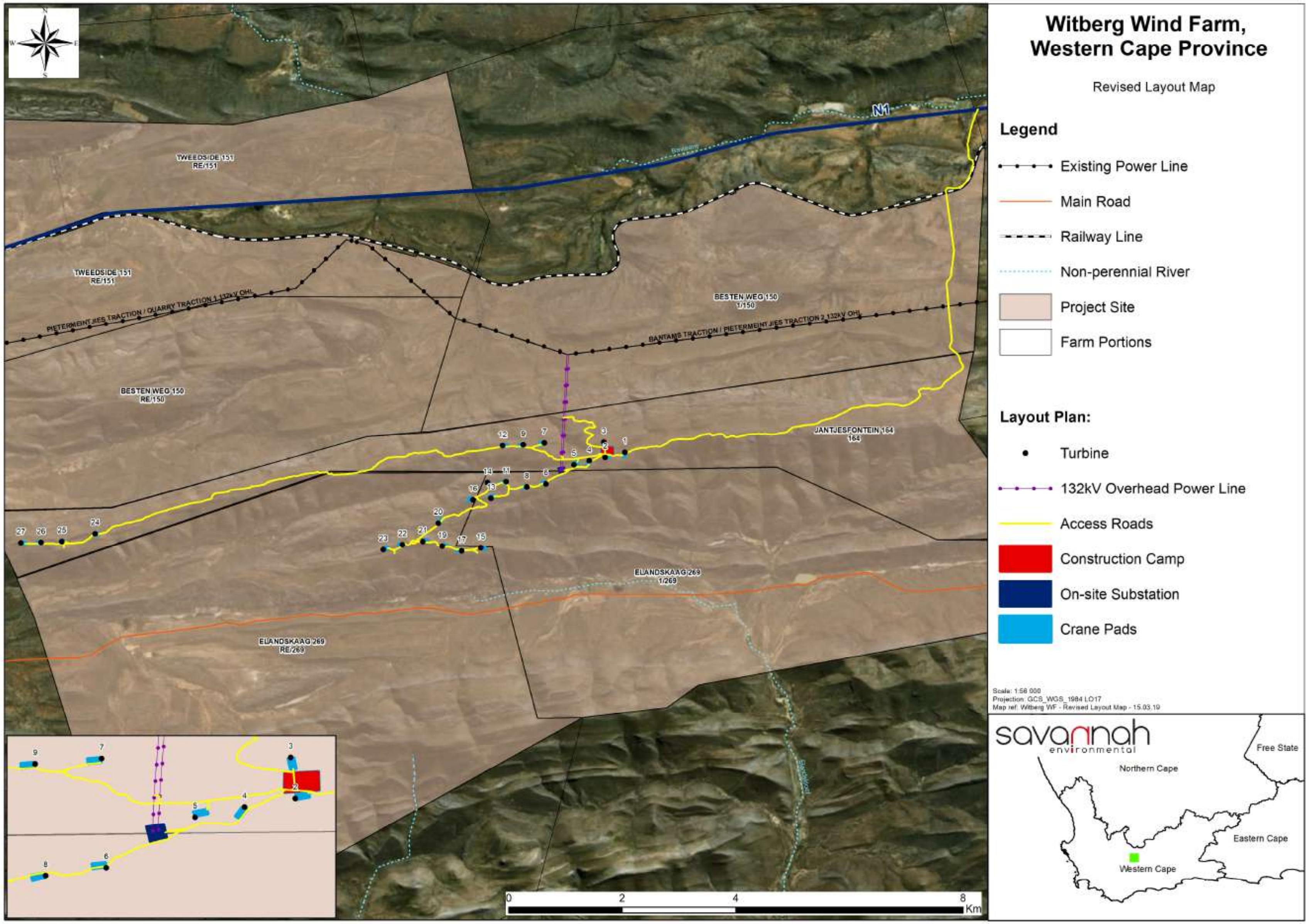

Figure 1.1: Revised Layout Map

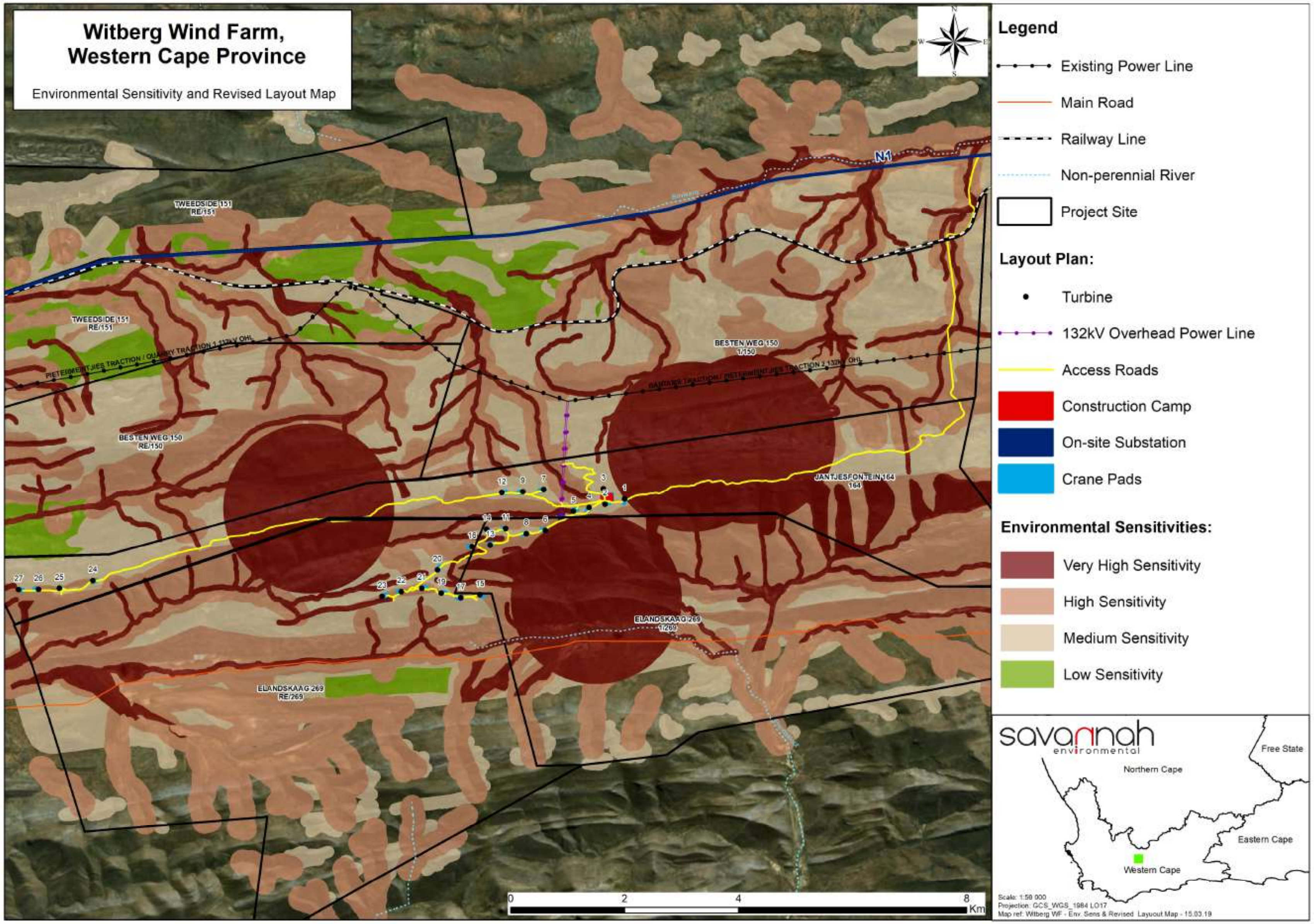

Figure 1.2: Revised Layout Map with Sensitivities

An Environmental Management Programme (EMPr) is a set of guidelines and actions aimed at ensuring that construction and/or installation activities, and subsequent management of facilities, are undertaken in a manner that minimises environmental risks and impacts.

An EMPr was prepared by ERM Southern Africa (Pty) Ltd, for G7 Renewable Energies (Pty) Ltd (Project Applicant subsequently amended to Witberg Wind Power (Pty) Ltd) for the proposed construction and operation of a wind energy facility (WEF) at the Witberg Wind Farm Site as part of the EIA process for the wind energy facility. This EMPr addresses potential impacts associated with the installation (construction), operation and decommissioning phases of the project.

The EMPr is required in order to:

- assist in ensuring continuing compliance with South African legislation and the Project Company's Environmental Health and Safety Policy (this policy is currently being developed);
- provide a mechanism for ensuring that measures identified in the EIA and subsequent amendments designed to mitigate potentially adverse impacts, are implemented;
- provide a framework for mitigating impacts that may be unforeseen or unidentified until construction is underway;
- provide assurance to regulators and stakeholders that the requirements with respect to environmental and socio-economic performance will be met; and
- provide a framework for compliance auditing and inspection programs.

In terms of Condition 13 of the Environmental Authorisation for the project dated October 2011, the EMPr was approved. The EMPr will, however, remain a living document. The document must therefore be adhered to and updated as relevant throughout the project life cycle.

The EMPr specifies the following:

- roles and responsibilities for implementation of the EMP (*Section 1.2*);
- subsidiary plans and policies (*Section 1.3*);
- stakeholder engagement (*Section 1.4*);
- requirements for micro-siting of turbines (*Section 1.5*);
- permit requirements (*Section 2*);
- biological monitoring requirements for pre-construction, construction and operation (*Section 3*);
- mitigation and compliance monitoring measures (*Section 4*); and
- contractor compliance standards (*Section 5*)

Since this EMPr is part of the environmental permitting process for the Witberg Wind Energy Facility, it is important that this document be read in conjunction with the EIA Report and all specialist reports compiled for this project. This will contextualise the EMPr and enable a thorough understanding of its role and purpose in the integrated environmental management process. All mitigation and management measures specified within this EMPr and within the EIA Report and associated specialist reports must be implemented. Should there be a conflict of interpretation between this EMPr and the Environmental Authorisation and subsequent amendments, the stipulations in the Environmental Authorisation and subsequent amendments shall prevail over that of the EMPr, unless otherwise agreed by the authorities in writing. Similarly, any provisions in legislation overrule any provisions or interpretations within this EMPr.

This EMPr is a revision of the EMPr compiled by ERM in July 2011 and has been updated on the basis of additional information provided by specialists through an Environmental Authorisation (EA) amendment process, as well as in accordance with the requirements of the EIA Regulations (2014), as amended (i.e. the current EIA Regulations). Changes made have been underlined for ease of reference. Where information has been removed, this is shown as "~~strikethrough~~" text.

This revised EMPr includes the following information provided in **Table 1.1** below, as required in terms of the EIA Regulations (2014), as amended, Appendix 3: Content of Environmental Impact Assessment reports.

Table 1.1: EMPr content requirements of Appendix 4 of the 2014 NEMA EIA Regulations, as amended, (GNR 326) as provided in this EMPr.

Requirement	**Relevant Section**
(1) An EMPr must comply with section 24N of the Act and include– (a) details of– (i) the EAP who prepared the EMPr; and (ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae;	See Section 1.11 and Appendix L.
(b) a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	See Section 1.4.
(c) a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	See Section 1.4.
(d) a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including– (i) planning and design; (ii) pre-construction activities; (iii) construction activities; (iv) rehabilitation of the environment after construction and where applicable post closure; and (v) where relevant, operation activities;	See Section 4.
(f) a description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraph (d) will be achieved, and must, where applicable, include actions to — (i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) comply with any prescribed environmental management standards or practices; (iii) comply with any applicable provisions of the Act regarding closure, where applicable; and (iv) comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable;	See Section 4.
(g) the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	See Section 3 and Section 4.
(h) the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	See Section 4.
(i) an indication of the persons who will be responsible for the implementation of the impact management actions;	See Section 4.
(j) the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	See Section 1.9 and Section 4.
(k) the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	See Section 4.
(l) a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	See Section 1.9 and Section 4.

Requirement	Relevant Section
(m) an environmental awareness plan describing the manner in which— (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	See Section 1.7.
(n) any specific information that may be required by the competent authority. Specific information required by the competent authority as per the comment letter dated 13 December 2019 included: (i) The Environmental Management Programme (EMPr) to be submitted as part of the final report must include the following: (ii) All recommendations and mitigation measures recorded in the final report and the specialist studies conducted. (iii) The final site layout map. (iv) Measures as dictated by the final site layout map and micro-siting. (v) An environmental sensitivity map indicating environmental sensitive areas and features identified during the basic assessment process. (vi) A map combining the final layout map superimposed (overlain) on the environmental sensitivity map. (vii) An alien invasive management plan to be implemented during construction and operation of the facility. The plan must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken. (viii) A plant rescue and protection plan which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site and be implemented prior to commencement of the construction phase. (ix) An avifauna monitoring and management plan to be implemented during the construction and operation of the facility. This plan must be drafted by a suitably qualified avifauna specialist. (x) A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility. Restoration must be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed u An open space management plan to be implemented during the construction and operation of the facility. (xi) A traffic management plan for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimize impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations. (xii) A transportation plan for the transport of components, main assembly cranes and other large pieces of equipment. (xiii) A storm water management plan to be implemented during the construction and operation of the facility. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion, The plan must include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures must promote	The response to each specific requirement is as follows: (i) All recommendations and mitigation measures recorded in the revised motivation report and associated specialist studies are included in this EMPr. (ii) Refer to Section 1 of the EMPr. (iii) Refer to Section 1 of the EMPr. (iv) Note that an EIA process was undertaken and not a Basic Assessment process for the original application. An amendment application is now being undertaken as submitted herein. For the environmental sensitivity map indicating environmental sensitive areas, please refer to Section 1 of the EMPr. (v) Refer to Section 1 of the EMPr. (vi) Refer to **Appendix B** of the EMPr. (vii) Refer to **Appendix D** of the EMPr. (viii) Refer to **Appendix G** of the EMPr. (ix) Refer to **Appendix C** of the EMPr. (x) Refer to **Appendix E** of the EMPr. (xi) Refer to **Appendix H** of the EMPr. (xii) Refer to **Appendix H**

Requirement	Relevant Section
the dissipation of storm water run-off. (xiv) A fire management plan to be implemented during the construction and operation of the facility. (xv) An erosion management plan for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion. (xvi) An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems. (xvii) Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct or indirect spillage of pollutants. The EAP must provide detailed motivation if any of the above requirements is not required by the proposed development and not included in the EMPr.	of the EMPr. (xiii) Refer to **Appendix I** of the EMPr. (xiv) Refer to **Appendix J** of the EMPr. (xv) Refer to **Appendix F** of the EMPr. (xvi) Refer to **Appendix K** of the EMPr. (xvii) Refer to **Section 4.2 Objective 13** of the EMPr (**Appendix K**). Detailed motivation has been provided for DEA comment (e)(viii) above. No other detailed motivation is required.
(2) Where a government notice by the Minister provides for a generic EMPr, such generic EMPr as indicated in such notice will apply.	No government notice has been currently published, and therefore does not apply.

1.4 Project Description

The authorised Witberg Wind Energy Facility (WEF) is located on a site ~9km west of Matjiesfontein in the Laingsburg Local Municipality, which falls within the jurisdiction of the Central Karoo District Municipality in the Western Cape Province. This development is to be constructed within the project site which comprises the following farm portions:

» Remainder of the Farm Jantjesfontein 164;
» Remainder of the Farm Besten Weg 150;
» Remainder of Portion 1 of the Farm Besten Weg 150;
» Remainder of the Farm Tweedside 151;
» Remainder of the Farm Elandskrag 269; and
» Portion 1 of the Farm Elandskrag 269.

Witberg Wind Power (Pty) Ltd received an Environmental Authorisation (EA) for the construction of Witberg Wind Energy Facility and associated infrastructure in the Western Cape Province (DEA ref: 12/12/20/1966) on 13 October 2011. An appeal decision (Reference: LSA 105-439), dated 13 August 2013, was subsequently issued by the Minister of Environmental Affairs reducing the number of originally authorised wind turbines from 70 to 27 turbines, along with revised turbine specifications. However, a number of amendments to the EA and the authorised turbine specifications according to the appeal decision were subsequently undertaken. Taking the amendments into consideration, the current updated project details are provided in **Table 1.2** below.

Table 1.2: Updated Technical Details

Component	Description / Details
Location of the site	Western Cape Province
Facility area	Up to 50ha
SG Codes	» Remainder of the Farm Jantjesfontein 164 - C04300000000016400000; » Remainder of the Farm Besten Weg 150 - C04300000000015000000; » Remainder of Portion 1 of the Farm Besten Weg 150 - C04300000000015000001; » Remainder of the Farm Tweedside 151 - C04300000000015100000; » Remainder of the Farm Elandskrag 269 - C04300000000026900000; and » Portion 1 of the Farm Elandskrag 269 - C04300000000026900001.
Site Access	Off the N1
Export capacity	Up to 120MW
Proposed technology	Wind turbines
Number of turbines	25
Hub height from ground level	Range from 92m to up to 120m
Rotor diameter	Range from 116m to up to 136m
Individual turbine capacity	Range from 3MW to up to 5MW
Associated infrastructure	» Turbine hardstand area » Substation/s » Overhead powerline/s connecting to the substation and collector substation » Underground power lines » Access roads » Maintenance and operation buildings » Internal road infrastructure » Laydown area and construction camp
Area occupied by substations	10 000m^2 equates to 1ha
Area occupied by individual hardstand area	2100m^2 (25 wind turbines – 52500m^2) 5.25ha
Area occupied by both permanent and construction lay-down areas	22 000m^2 (2.2ha)
Area occupied by buildings	Within the 1ha of the substation
Width and length of internal roads	12m width 28km length total would equate to 33.6ha
Proximity to grid connection	2.5km

1.5 Roles and Responsibilities

The following section outlines the roles and responsibilities of those involved in the proposed installation, operation and decommissioning of the wind energy facility. An organogram showing reporting structures is provided in **Figure 1.3**.

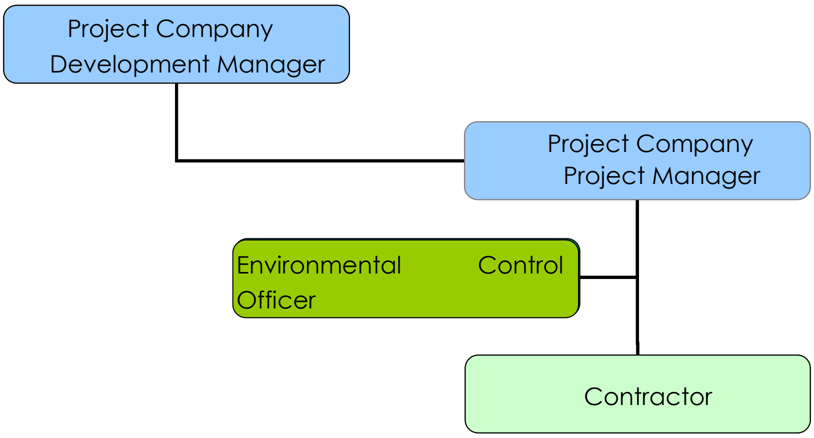

Figure 1.3: Reporting Structures

1.5.1 Project Company

The Project Company's Development Manager will have the ultimate responsibility for ensuring the measures outlined in the EMP are delivered and that the measures are implemented by their contractors and subcontractors. In this respect, the Project Company's Development Manager will review and approve contractor plans for delivery of the actions contained in the EMP during construction and ensure that during operation performance will be evaluated through monitoring and auditing.

- *Development Manager*
  The Development Manager's responsibilities will encompass the following:
  - Liaison with the project engineers to ensure that the Wind Farm is designed to meet all the specified environmental parameters and legal requirements as specified in the EMP and Environmental Authorisation;
  - Authority to stop works in emergency situations;
  - Approval of method statements; and
  - Liaison with authorities.

- *Project Manager*
  The Project Manager, ~~Kilian Hagemann,~~ or any other person appointed to the role, is the designated person responsible for the implementation of the EMP and therefore the person responsible for managing the environmental issues that arise during the construction phase of the project. The Project Manager will report directly to the Development Manager on environmental, health and safety matters.

The Project Manager's main role is to regularly inspect and manage the construction activities on site in order to ensure compliance with the EMP. The Project Manager will liaise with the Environmental Control Officer (ECO) and Contractor and report to the Development Manager.

The Project Manager's responsibilities will encompass the following:

- Training of contractors on environmental matters (see *Section1.2.4*);
- Inspect the site at least once every two weeks for the duration of the construction phase;
- Management of the contractors in terms of the EMP;
- Review of contractor method statements and ensure alignment with the EMP;
- Reporting on environmental problems to the Development Manager;
- Record keeping of:
    - environmental incidents;
    - contractor's non-compliance to the EMP; and
    - contractor fines and penalties.
- Making recommendations or implementing actions relating to a contractor's failure to comply with the EMP, which may include enforcement of penalties and even contract termination and removal of contactor from the site;
- Recommend the suspension of work activities where such activities contravene the EMP requirements; and
- The authority to stop works in emergency situations when the Development Manager is not available and construction activities seriously threaten the environment.

The Project Manager will also be responsible for implementing the community engagement plan. The Project Manager will be required to participate in community meetings that will be held in affected communities prior to, during and upon completion of construction.

During the construction phase an Environmental Control Officer (ECO) will be responsible for ensuring the overall environmental and socio-economic objectives of the EMP are met. Specialists such as palaeontologists, bird specialists etc. will be employed as required <u>and shall report to the ECO any issues identified on site</u>. When working on site, the ECO will report to the Project Manager.

1.5.2 Environmental Control Officer

<u>The Project Company</u> will appoint an independent Environmental Control Officer (ECO) prior to commencement of construction and throughout the construction phase of the project until such time as rehabilitation is complete and the site is ready for operation. The ECO shall hold a relevant environmental degree or diploma and have a few years of experience in ECO work.

The primary role of the ECO will be to monitor the construction activities and ensure that the mitigation measures of the EMP and ~~Environmental Authorisation (~~EA~~)~~ are implemented.

The ECO's responsibilities will encompass the following:

- Brief the Contractor on EMP requirements and site layout;
- Retain a copy of the EMP and EA and all records relating to monitoring and auditing on site, and keep these available for inspection;
- Visit the site at least once a day, particularly for the following activities:
  - Site clearance;
  - Excavation;
  - Turbine arrival, assembly and placement;
  - Set up of concrete batching (if required); and
  - Establishment of all works areas including latrines and wash areas.

- Specific tasks of the ECO will include ensuring:
  - Sensitive areas are demarcated and cordoned off;
  - Activities are restricted to demarcated works areas;
  - No sensitive features are damaged or disturbed as specified in the EMP and EA;
  - Any notifiable features (e.g. fossils or other heritage remains) are recorded and work stopped or redirected to avoid such areas, and the appropriate authorities informed, and the following protocol is implemented as specified by the competent authority;
  - All incidents (including but not limited to environmental incidents) are recorded in a logbook and appropriate remedial action taken and reported where necessary;
  - Site visit reports are kept and feedback provided to the Project Manager and other senior management, as required; and
  - Liaise with DEA regarding implementation of the EMP, if and when required.

The ECO will be expected to be contactable telephonically in case of emergencies at all times.

1.5.3 Contractors and Site Personnel

During site preparation and construction, the contractor will be responsible for ensuring compliance with all relevant legislation as well as adherence to all environmental and socio-economic mitigation measures specified in the EMP. The contractor is also responsible under the contract for managing the potential environmental, socio-economic, safety and health impacts of all contracted activities whether these are undertaken by themselves or by their subcontractors. The contractor has overriding responsibility for the activities of all direct staff and subcontractors.

Adherence to the provisions of the EMP will be a condition of contract with the contractor. The contractor will need to demonstrate to the Project Company's satisfaction how compliance with the requirements of the EMP will be met. The contractor will also be expected to demonstrate commitment to the EMP at all levels in the contractor's management structure and will be required to identify individuals responsible for overall environment, socio-economic, safety and health management.

The contractor will be required to undertake regular environmental and socio-economic inspections and provide reports to the Project Company to monitor and evaluate performance against the measures and objectives established in the EMP. In this regard, the contractor's performance in complying with the EMP will be monitored and audited by the ECO, Project Manager and Project Manager's Development Manager.

1.6 Allocation of Resources

Financial and personnel resources must be allocated to the implementation of the EMP, including provisions for contractor training and environmental awareness, contingencies to deal with environmental emergencies, monitoring and auditing. Such resources must be available during the operational and decommissioning, as well as the construction phase.

Environmental requirements requiring cost allocation must be clearly identified the terms of reference for contractors and suppliers to ensure these service and the associated service providers are budgeted for effectively.

1.7 Training and HSE Awareness

Training and awareness raising around health, safety and environmental (HSE) issues is essential for ensuring that the EMP is effectively implemented and that unforeseen HSE incidents are managed timeously and appropriately. The ultimate responsibility for environmental training and awareness raising rests with the Project Company.

It is suggested that the following be included in the approach to training and awareness raising:

- Induction course/briefing for all contractors including a description of the Project Company's expectations, specific responsibilities of wind farm workers with regard to HSE issues. The briefing will usually take the form of an on-site talk and demonstration by the ECO. The education / awareness programme should be aimed at all levels of personnel within the contractor's team;
- Refresher courses as and when required;
- Focused training sessions in relation to specific tasks, such as the erection of turbines; and
- Toolbox talks to alert workers to particular HSE concerns associated with their tasks for the day/period they are on site and to encourage generally responsible behaviour on site.

Courses should be provided by a qualified person and in a language and medium understood by contractors/employees.

1.8 Documentation and Record Keeping

All documentation relevant to the implementation of the EMP during construction, operation and decommissioning must be maintained on site in a structured and ordered manner. These documents should be distributed in a controlled manner to affected personnel and must also be made available for public / authority inspection, if requested.

The type of documents that should be managed and retained include, at minimum:

- Method statements;
- Policies and plans;
- Project specific HSE audit reports;
- Training material and records of attendance;
- Incident reports;
- Complaints register;

- Site access register;
- EMP;
- EA;
- Emergency preparedness and response procedures;
- Monitoring reports; and
- Minutes of key meetings with service providers and project team members.

1.9 Auditing and Reporting

Auditing by an external, independent auditor should be undertaken at the end of both the construction and rehabilitation phases, as well as annually thereafter during operation. After each audit a report should be submitted to the DEA and other relevant authorities. The audit must cover compliance with any specific conditions included in the EA as well as specific management actions included in this EMP and EA. The completed audit reports must be accurately dated and form part of the document control system. Report back to stakeholders should be undertaken after each audit.

Regular audits should be undertaken by the independent ECO during construction and the resultant independent audit reports will be communicated with senior management within the Project Company and sent to the DEA and other relevant authorities as and when required.

1.10 Revision of the EMPr

The EMPr will, however, remain a living document. The document must therefore be adhered to and updated as relevant throughout the project life cycle. The EMPr may be subject to review by senior management responsible for the project at the following stages of the project:

- Prior to the initiation of the construction phase (post pre-construction monitoring) to ensure that all relevant management actions have been included;
- Following the construction and rehabilitation phase and after the start of operation, to capture additional and unforeseen mitigation measures that are identified during these activities, and would be relevant to the operational phase;
- Prior to final decommissioning and closure.

This EMPr is a revision of the EMPr compiled by ERM in July 2011, and approved by the DEA in October 2011, and has been updated on the basis of additional information provided by specialists through an Environmental Authorisation (EA) amendment process, as well as the requirements of the EIA Regulations (2014), as amended. Changes made have been underlined for ease of reference. Where information has been removed, this is shown as "~~strikethrough~~" text.

1.11 Details and Expertise of the Environmental Assessment Practitioner (EAP) responsible for the compilation of the Revised EMPr

Savannah Environmental is a leading provider of integrated environmental and social consulting, advisory and management services with considerable experience in the fields of environmental assessment and management. The company is wholly woman-owned (51% black woman-owned), and is rated as a Level 2 Broad-based Black Economic Empowerment (B-BBEE) Contributor. Savannah Environmental's team have been actively involved in undertaking environmental studies over the past 13 years, for a wide variety of projects throughout South Africa, including those associated with electricity generation and infrastructure development.

The amendment process is managed by Jo-Anne Thomas. She is supported by Shaun Taylor and Nicolene Venter.

- **Jo-Anne Thomas** is a Director at Savannah Environmental (Pty) Ltd and the registered EAP for the EIA for this project. Jo-Anne holds a Master of Science Degree in Botany (M.Sc. Botany) from the University of the Witwatersrand, and is registered as a Professional Natural Scientist (400024/2000) with the South African Council for Natural Scientific Professions (SACNASP). She has over 20 years of experience in the field of environmental assessment and management, and the management of large environmental assessment and management projects. During this time she has managed and coordinated a multitude of large-scale infrastructure EIAs, and is also well versed in the management and leadership of teams of specialist consultants, and dynamic stakeholders. Jo-Anne has been responsible for providing technical input for projects in the environmental management field, specialising in Strategic Environmental Advice, EIA studies, environmental permitting, public participation, EMPs and EMPrs, environmental policy, strategy and guideline formulation, and integrated environmental management (IEM). Her responsibilities for environmental studies include project management, review and integration of specialist studies, identification and assessment of potential negative environmental impacts and benefits, and the identification of mitigation measures, and compilation of reports in accordance with applicable environmental legislation.

- **Shaun Taylor** is an Environmental and Lead Permitting Consultant at Savannah Environmental. Shaun's highest qualification is a Master of Science Degree in Aquatic Health. Shaun has an in-depth understanding of environmental and water related South African legislation. Applicable legislation includes the National Environmental Management Act, 1998 (Act No. 107 of 1998), the Environmental Impact Assessment (EIA) Regulations (2006, 2010 and 2014, as amended) and the National Water Act, 1998 (Act No. 36 of 1998). Over and above a number of other projects, Shaun has successfully conducted and obtained environmental approvals for numerous renewable energy (wind and solar) developments as well as for infrastructure (roads, water pipeline and power line) related projects. Shaun has excellent experience in dealing with the entire environmental authorization (EA) process from beginning to end i.e. submission of applications, undertaking Environmental Impact Assessments and Basic Assessments (BAs), conducting EA amendments, extension applications and compiling Draft and Final Environmental Management Programmes (EMPrs). Shaun is well acquainted and experienced in dealing with the key provincial and national environmental authorities, other organs of state as well as any other key stakeholders.

- **Nicolene Venter** is a Social and Public Participation Consultant at Savannah Environmental. Nicolene has a Higher Secretarial Certificate from Pretoria Technicon, and a Certificate in Public Relations from the Public Relation Institute of South Africa at Damelin Management School. Nicolene has over 21 years of experience as a Public Participation Practitioner and Stakeholder Consultant, and is a Board Member of the International Association for Public Participation Southern Africa (IAP2SA). Nicolene's experience includes managing the stakeholder engagement components of large and complex environmental authorisation processes across many sectors, with particular experience in the power sector. Most notably on large linear power lines and distribution lines, as well as renewable energy projects. Nicolene is well versed with local regulatory requirements as well as international best practice principles for community consultation and stakeholder engagement, as well as international guidelines and performance standards. Nicolene is responsible for managing the Public Participation process required as part of the EIA for this project.

Savannah Environmental's team have been actively involved in undertaking environmental studies over the past 13 years, for a wide variety of projects throughout South Africa, including those associated with electricity generation and infrastructure development, and therefore have extensive knowledge and experience in EIAs and environmental management, having managed and drafted EMPrs for numerous other power generation projects throughout South Africa. Curricula Vitae (CVs) detailing the Savannah Environmental team's expertise and relevant experience are provided in **Appendix L** to this EMPr Report.

1.12 Subsidiary Plans and Policies

Environmental and socio-economic management issues at various stages in the life of the project from detailed design through to decommissioning, are governed or guided by a number of standards, including:

- those contained in South African legislation;
- those established by industry codes of practice;
- those required by the Project Company's policy or manufactures specifications;
- those within relevant international standards (e.g. World Bank environmental guidelines, IFC Performance Standards, World Health Organisation, International Labour Organisation); and
- commitments made in the EIA.

Prior to construction a number of subsidiary plans, policies and monitoring programmes will be required to manage various activities or potential risks. These are summarised in *Box 1.1*.

Box 1.1 Summary of Subsidiary Plans, Policies and Programmes required for the EMPr

Policies, Plans and Programmes to be developed

- Environmental Policy
- Recruitment Policy
- Local Procurement Policy
- Health and Safety Policy
- Bat Monitoring Programme
- Bird Monitoring Programme
- Code of Conduct
- Emergency Response Plan
- Incident Reporting Procedure
- Health and Safety Plan
- Traffic Management Plan
- Waste Management Plan
- Spoil Management Plan
- Community Development Trust Plan
- Community Engagement Plan (CEP)
- Recruitment Policy
- Local Procurement Policy

In response to the requirements of the DEA, the following plans have been included within this EMPr:

Plan	Appendix
Alien Invasive Management Plan	Appendix B
Re-vegetation and Habitat Rehabilitation Plan	Appendix C
Plant Rescue and Protection Plan	Appendix D
Open Space Management Plan	Appendix E
Erosion Management Plan	Appendix F
Avifauna Monitoring and Management Guidelines	Appendix G
Traffic and Transportation Management Plan	Appendix H
Stormwater Management Plan	Appendix I
Emergency Preparedness, Response and Fire Management Plan	Appendix J
Waste Management Plan	Appendix K

These plans should be updated throughout the life-cycle of the wind energy facility, as required in order to ensure that appropriate measures are in place to manage environmental impacts, and to ensure compliance with relevant legislation.

1.13 Stakeholder Engagement

The Project Company will continue to engage with stakeholders throughout project construction and operation. Communication with local communities and other local stakeholders will be a key part of this engagement process and will require The Project Company and the contractor to work closely during the construction period. Development of a Community Engagement Plan (CEP) will be important to facilitate this communication.

The objectives of communication and liaison with local communities are the following.

- To provide residents in the vicinity of the wind farm (e.g. neighbouring landowners/ farmers and other residents) and other interested stakeholders, with regular information on the progress of work and its implications.
- To monitor implementation of mitigation measures and the impact of construction on communities via direct monitoring and feedback from those affected in order to ensure that mitigation measures are implemented and the mitigation objectives achieved.
- To manage any disputes that may arise between the Project Company, the contractors and local people.

This engagement process can serve to inform the establishment and provisions of the Community Development Trust linked to the project.

1.13.1 Grievance Procedure

The Project Company should develop a grievance procedure to ensure fair and prompt resolution of problems that may arise from the project. The grievance procedure should be underpinned by the following principles and commitments:

- Implement a transparent grievance procedure, and disseminate key information to directly impacted stakeholders.
- Seek to resolve all grievances timeously.

- Maintain full written records of each grievance case and the associated process of resolution and outcome for transparent, external reporting.

The responsibility for resolution of grievances will lie with the Project Company and its contractors.

1.14 Micro-Siting of Turbines

The amended layout has been designed based on a combination of the sensitivity constraints mapping of the site identified by specialists during the EIA process, amendment process and available wind resource mapping and data from the Project Company.

The turbine positions may be micro-sited based on additional site data from the following sources:

- geotechnical investigations;
- pre-construction monitoring data; and
- specific site checks by ecologist, heritage and palaeontological specialist.

Micro-siting will be done as part of the detailed site planning process to ensure that the environmental risks are minimised and the technical requirements of the project can be achieved. Micro-siting will ensure that the turbine positions will be located in areas not mapped as very high sensitivity and that any environmental constraints at the specific turbine positions and road alignments are identified, avoided or managed. The final layout after micro-siting has taken place, following selection of the project as a Preferred Bidder, will need to be approved by the Department of Environmental Affairs (DEA).

2 PERMIT REQUIREMENTS

Activities undertaken during site preparation, construction and operation may require additional permits, over and above the Environmental Authorisation. The Project Company is responsible for ensuring that the necessary permits are in place in order to comply with national and local regulations. Additional permit requirements are described below.

2.1 Heritage

The protection and management of South Africa's heritage resources is controlled by the National Heritage Resources Act (NHRA), 1999 (Act No. 25 of 1999). The objective of the NHRA is to introduce an integrated system for the management of national heritage resources.

- *Archaeology, Palaeontology and Meteorites*
  According to Section 35 (Archaeology, Palaeontology and Meteorites) and Section 38 (Heritage Resources Management) of the South African National Heritage Resources Act, palaeontological heritage impact assessments (PIAs) and archaeological impact assessments (AIAs) are required by law in the case of developments in areas underlain by potentially fossiliferous (fossil-bearing) rocks, especially where substantial bedrock excavations are envisaged, and where human settlement is known to have occurred during prehistory and the historic period. Depending on the sensitivity of the fossil and archaeological heritage, and the scale of the development concerned, the palaeontological, and archaeological impact assessment required may take the form of (a) a stand-alone desktop study, or (b) a field scoping plus desktop study leading to a consolidated report. In

some cases, these studies may recommend further palaeontological and archaeological mitigation, usually at the construction phase. These recommendations would normally be endorsed by the responsible heritage management authority, in this case Heritage Western Cape (HWC), to whom the reports are submitted for review. *Table 2.1* outlines when a permit is required depending on the sensitivity of the heritage resources.

Table 2.1 Permitting requirements for fossil, built environment and Stone Age archaeology

PERMIT APPLICATION SECTION 35 – FOSSILS, BUILT ENVIRONMENT FEATURES, SHIPWRECKS & STONE AGE ARCHAEOLOGY (Ref : NHRA 1999: 58):
(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite; (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite; (c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite.

- <u>*Burial Grounds and Graves*</u>
  A Section 36 permit application is made to the South African Heritage Resources Agency (SAHRA) which protects burial grounds and graves that are older than 60 years, and must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit. SAHRA must also identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with these graves and must maintain such memorials. A permit is required under the conditions listed in *Table 2.2*.

Table 2.2 Permitting requirements for burial grounds and graves older than 60 years to Heritage Western Cape (HWC) and historic burials to the South African Heritage Resources Agency (SAHRA)

PERMIT APPLICATION SECTION 36 – BURIAL GROUNDS & GRAVES (REF: NHRA 1999: 60)	
(a)	destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves
(b)	destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
(c)	bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals
(d)	SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant

Table 2.3 Permitting requirements for heritage resources management

PERMIT APPLICATION SECTION 38 (Ref: NHRA 1999: 62)

PERMIT APPLICATION SECTION 38 (Ref: NHRA 1999: 62)

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
(b) the construction of a bridge or similar structure exceeding 50 m in length;
(c) any development or other activity which will change the character of a site exceeding 5 000 m^2 in extent; or
  (ii) involving three or more existing erven or subdivisions thereof; or
  (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
  (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

2.2 Borrow Pits

A borrow pit refers to an open pit where material (soil, sand or gravel rock) is removed for use at another location. The Project Company is likely to require the use of borrow pits for certain earthworks operations, such as the construction of roads, embankments, bunds, berms, and other structures.

The establishment of borrow pits is regarded as a mining activity and is legislated in terms of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). A mining permit and Environmental Authorisation in terms of the EIA Regulations must be obtained from the Department of Mineral Resources prior to the establishment of borrow pits on the site.

2.3 Water Use

There are licensing procedures that need to be followed for particular "water uses". Water uses that may be of relevance to the development of wind farms and associated road construction include the following:

- Taking of water from a water resource, including a water course, surface water, estuary or aquifer (i.e. borehole)
- altering the bed, banks, course or characteristics of a water course; and/or
- impeding or diverting of a flow in a water course.

2.4 Abnormal Vehicle Loads

Wind turbine components will be delivered to site using road transport and due to the size of the components, the vehicles used to deliver turbine components will be considered abnormal loads in terms of the Road Traffic Act (Act No 29 of 1989). A permit for a vehicle carrying an abnormal load must be obtained from the relevant Provincial Authority. The vehicle must comply with the Administrative Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads, issued by the Department of Transport, 2009.

2.5 Access from the N1

The site would be accessed via the N1. The intersections with the N1 will have to be upgraded to facilitate the transport of the turbine components (blades, tower sections, nacelle, hub) and other construction materials to the site. There will be one access roads accessing the east of the site from the N1 and connecting the N1 with the turbine rows.: one accessing the centre of the site from the N1. The existing servitude road to the Bantams Traction Station and existing telecommunications facilities will be used for the development (with approval from the owners). Approval from the South African National Roads Agency (SANRAL) will be required for the upgrade of the road intersection with the N1.

2.6 Aviation Communications

Written approval or a permit must be obtained from the South African Civil Aviation Authority that the wind farm will not interfere with the performance of aerodrome radio Communication, Navigation and Surveillance (CNS) equipment, especially radar. The approval or permit must be submitted to the Director: Environmental Impact Evaluation.

3 BIOLOGICAL MONITORING

3.1 Introduction

Specific biological monitoring requirements that are required to be undertaken through the various phases of the Witberg Wind Farm have been identified through specialist studies and are identified in this section. Biological monitoring is required during the pre-construction, construction and operational phases of the project, particularly for birds and bats.

Table 3.1 provides a summary of what monitoring is required at the various phases of the development. The Project Company is responsible for ensuring that all monitoring measures described in this section are undertaken by appointing the relevant specialists where necessary.

Table 3.1 Monitoring Requirements

	Ecology	Bats	Birds	Climatic Effects
Pre-construction	X	X	X	
Construction	X			
Operational	X	X	X	X

3.2 Pre-construction Phase

Pre-construction monitoring is an essential requirement prior to construction in order to validate within reason that final turbine placement and arrangement, as well as mitigation and management measures as included in this EMP, will minimize potential impacts on birds, bats and other terrestrial ecological components and also in order to gain consequential knowledge for future wind farm projects to be developed in the country. ~~A year of monitoring prior to wind farm development, design and construction is a legal requirement in Europe for wind farm development.~~

3.2.1 Ecological Pre-construction Walk-Through (excluding Bats and Birds)

- Monitoring Impacts on Rare or Endangered Plant Species
  There are a number of listed plant species which may occur at the site. A pre-construction walk-through must take place prior to construction to identify listed species within areas that will be impacted by the development. The following recommendations are made in this regard:

  - Species such as geophytes and succulents which are likely to be good candidates for translocation, should be marked so that they can be relocated to an adjacent similar environment at the appropriate time, which would be during the winter or spring for most species except geophytes which would be better translocated during the late summer.
  - Number and identities of all species translocated should be recorded.
  - Relocated individuals should be marked and monitored for at least a year after transplanting to establish the success rate of the relocation exercise.

3.2.2 Bat Monitoring

~~Due to the large extent of the site and the relative diversity of habitats, two different monitoring regimes are recommended for the current wind energy project:~~

- ~~Pre-construction passive monitoring:~~
  - ~~By means of installing a few passive ultrasonic recorders for bats designed for long-term out-door usage.~~
  - ~~Data from these machines can be downloaded monthly for a monitoring period of one calendar year.~~

~~Monitoring should be conducted along the length of the Witberg Wind Farm site for a full year across seasons to straddle the times that bats migrate (predicted to be April/May and August/September) and during mid-summer (November to February) to inform the siting of turbines and to determine if the site is fatally flawed in terms of bat migration patterns. Monitoring should be done over extended periods within each season, e.g. several weeks at 3-4 days per week. Research on seasonal and diurnal activity rhythms is sorely needed for all of the bat fauna in South Africa.~~

~~Bat activity should be assessed with detectors placed at ground level, as well as 30 m above ground. The pre-construction 80 m wind measuring masts are important monitoring points and allow for elevated sampling to record bats that may fly at heights similar to the of the rotor reach.~~

~~It is assumed that most bat detectors have a detection range of approximately 20 - 30m, therefore, many monitoring sites would be required to cover the site completely. However, this will not be financially feasible. Therefore, it can be predicted that 6 monitoring stations should adequately allow for a refined impact assessment and to adequately inform turbine siting over the proposed approximately 16km site length. The final number of monitoring points will be determined closer to the study.~~

~~Various passive monitoring systems are available and the most technically and cost-efficient ultrasonic recording equipment for the job will be investigated. Such systems include:~~

- ~~ANABAT SD2 (Titley Electronics PO Box 19Ballina NSW 2478, Australia info@titley.com.au, http://www.titley.com.au/batdetection.htm) that enables the remote downloading of echolocation data would allow the collection of data over extended periods.~~
- ~~Song Meter SM2BAT Terrestrial Ultrasonic Recorder (http://www.wildlifeacoustics.com/sm2_bats.php)~~

~~The sound data will be recorded and saved into several files. These sound files (usually .WAV files) will be analysed using sound analysis software, such as Bat Sound Pro, Bat Scan 9, Sonobat, etc.~~

~~In order to supplement the information obtained from passive monitoring regular bat netting will take place at key habitat features during the year. Any bats that are captured by the mist nets will be weighed, measured (e.g. forearm length, noseleaf dimensions, etc.), photographed and released. Release calls will be recorded for comparison with the passive data.~~

~~Voucher specimens or samples will only be taken, if there is doubt with regard to the species type (as approved by an existing Cape Nature permit).~~

~~All appropriate data collected will undergo statistical analysis for input into the monitoring report.~~

Bat monitoring has been undertaken by Werner Marais of Animalia cc, the results of which are detailed in the pre-construction bat monitoring report dated 2015. Pre-construction monitoring has been undertaken and the additional mitigation measures as a result of the pre-construction monitoring report have been included in this revised EMPr in the relevant phases of the proposed development. Should further pre-construction monitoring be required in terms of the latest guidelines, this will need to be undertaken accordingly.

3.2.3 Bird Monitoring

~~A long-term monitoring programme has been recommended to confirm the potential impacts on birds and to identify additional mitigation measures that may be required to ameliorate these impacts. Pre-construction bird monitoring is recommended to extend over the course of a year (ideally) or for at least six months prior to construction to provide an understanding of bird densities, presence and abundance and movement patterns and potential impacts of the wind facility. The primary aims of a long-term pre-construction monitoring programme are to determine the densities of birds resident within the impact area, document patterns of bird activity and movements in the vicinity of site, monitor patterns of bird activity and movement in relation to weather conditions, time of day and season and share key findings with the industry and other relevant stakeholders to ensure that the collective knowledge and understanding of the interface between South African birds and wind energy development is advanced as quickly and accurately as possible.~~

~~Pre-construction monitoring would determine the need for any additional mitigation requirements to be implemented during the construction or operational phases of the development and should be undertaken in the 6-12 months preceding construction.~~

- ~~Avian densities~~
  ~~A set of at least 10 walk-transect routes, each of at least 1000 m in length, should be established in areas representative of all the avian habitats present within a 10 km radius of the centre of the Witberg site. Each of these should be walked at least once every two months over the 6-12 months preceding construction. The transects should be walked after 06h00 and before 09h00, and the species, number and perpendicular distance from the transect line of all birds seen should be recorded for subsequent analysis and comparison. In addition:~~

  - ~~The cliff-lines within or close to the development area should be surveyed for cliff-nesting raptors at least every six months using documented protocols (Malan 2009).~~
  - ~~Known large eagle nest sites should also be checked twice annually for signs of occupation and breeding activity.~~
  - ~~All sightings of key species at or near the site (Table 6.1 of *Annex G* of EIR) should be carefully plotted and documented.~~

- ~~Bird activity monitoring~~
  ~~Monitoring of bird activity in the vicinity of the Wind Farm by should be done over a 2-3 day period at least every two months for the 6-12 months preceding construction. Each monitoring day should involve:~~

- ~~Half-day counts of all priority species flying over or past the wind farm impact area (see passage rates below, and note the stipulated use of radar as a companion to active pre-construction monitoring)~~
- ~~Opportunistic surveys of cranes (and bustards) and raptors seen when travelling around the Witberg site.~~

- ~~Passage rates of priority bird species~~

  ~~Counts of bird traffic over and around the proposed Wind Farm should be conducted from suitable vantage points (and a number of these should be selected and used to provide coverage of avian flights in relation to all areas of the wind farm), and extend alternately from an hour before dawn to midday, or from midday to an hour after dusk, so that the equivalent of four full days of counts is completed each count period. This should provide an adequate (if minimal) sample of bird movements around the facility in relation to a representative cross-section of conditions and times of day, for all seasons of the year.~~

  ~~Once in position at the selected count station, the observer should record (preferably on a specially designed data sheet) the date, count number, start-time and conditions at start - extent of cloud cover, temperature, wind velocity and visibility – and proceed with the count. The counts should detail all individuals or flocks of the stipulated priority bird species, all raptors, and any additional species of particular interest or conservation concern, seen flying within 500 m of the envisaged or actual periphery of the wind farm. Each record should include the following data: time, updated weather assessment, species, number, mode of flight (flapping, gliding, soaring), flight activity (commuting, hunting other), direction of flight, vertical zoning relative to the envisaged or actual turbine string (low – below the rotor arc, medium – within the rotor arc, medium-high - within c.100 m of the upper rotor arc, high – >100 m above the upper rotor arc), and horizontal zoning relative to the envisaged or actual turbine array (near – through the turbine string or within the outer rotor arc, middle – within c.100 m of the outer rotor arc, distant - >100 m beyond the outer rotor arc). The time and weather conditions should again be noted at the end of each count.~~

<u>Bird monitoring has been undertaken by Dr. Rob Simmons of Birds and Bats Unlimited, the results of which are in the pre-construction bird monitoring report dated 2015. Pre-construction monitoring has been undertaken and the additional mitigation measures as a result of the pre-construction monitoring report have been included in this revised EMPr in the relevant phases of the proposed development. Should further pre-construction monitoring be required in terms of the latest guidelines, this will need to be undertaken accordingly.</u>

3.3 Construction Phase

Mammals, reptiles and amphibians are most likely to be exposed to impacts during the construction phase of the Witberg Wind Farm primarily through loss of habitat and impacts associated with construction vehicles and workforce. This section describes the biological monitoring measures that should be undertaken during the construction phase.

3.3.1 Ecological Monitoring (excluding Bats and Birds)

In general, during the construction phase, monitoring should be used to ensure that the development takes place within the guidelines provided by this document to ensure that construction minimises or avoids impacts on adjacent natural vegetation, fauna and ecosystems. This monitoring could be undertaken by the ECO.

- <u>Monitoring Loss of Habitat and Habitat Fragmentation</u>
  Habitat loss and fragmentation is primarily a concern during the construction phase since this is when the majority of disturbance will take place. Monitoring should thus focus on ensuring that construction takes place within the guidelines stated in this document and other the relevant mitigation guidelines contained within the other specialist reports. Specific areas that should be monitored include:

  - Any deviations from the final construction plan, including the location, extent and nature of vegetation impact and transformation.
  - The location and extent of temporary lay-down areas, these should be included in the sweeps for alien species.
  - Any inadvertent or otherwise unintended destruction of natural vegetation and the remediation steps taken to encourage the recovery of the impacted areas.
  - Monitoring frequency would need to be high, daily or weekly during the construction phase. During the operational phase monitoring could be conducted on an ad-hoc basis coincide with maintenance activities that may impact natural vegetation, such as servicing of the turbines.
  - During the operational phase, it is recommended that a fire monitoring system is set in place to record the date, extent and source of all fires at the site. Fire is a key ecological driver in fynbos vegetation and the extent to which the development impacts the fire regime at the site should be established so as to better inform long-term fire management at the site.

- <u>Monitoring Impacts on Sensitive Environments</u>
  The sensitive environments at the site require specific attention to avoid and mitigate negative impacts to these areas. Sensitive areas include rare edaphic environments as well as drainage lines, seeps and wetlands. These areas will be particularly vulnerable to negative impact during the construction phase when the major infrastructure associated with the development is laid down. During the construction phase, monitoring should largely be directed towards enforcement to ensure that these areas are not negatively impacted. As such, monitoring of these aspects should be on a continuous basis. During the operational phase there are not likely to be many activities which pose a direct risk to these areas. Specific recommendations include:

  - Before roads are constructed, their proposed routes should be inspected on foot and all wetlands and riparian areas mapped and recorded on a GPS. Where planned roads traverse wetlands, these should be rerouted so as to avoid the wetlands. The services of an ecologist trained in the field may be required to accurately identify and delineate the wetlands.
  - Where roads traverse rivers and drainage lines, the sites should be monitored to ensure that the presence of the road is not resulting in erosion or the deposition of large amounts of silt.
  - The state of vulnerable wetlands near to roads should be recorded, preferably during the late wet season. A repeat photography method is suggested as a simple yet cost effective manner for monitoring wetland state. It is important to note that near and close-up pictures would be required to adequately assess changes in wetland state.

- <u>Monitoring Impacts on Rare or Endangered Plant Species</u>

There are a number of listed plant species which may occur at the site. Monitoring should occur pre-construction to identify listed species within areas that will be impacted by the development. The following recommendations are made in this regard:

- Species such as geophytes and succulents which are likely to be good candidates for translocation, should be marked so that they can be relocated to an adjacent similar environment at the appropriate time, which would be during the winter or spring for most species except geophytes which would be better translocated during the late summer.
- Number and identities of all species translocated should be recorded.
- Relocated individuals should be marked and monitored for at least a year after transplanting to establish the success rate of the relocation exercise.

- <u>Monitoring Direct Faunal Impacts</u>

  Particularly during the construction phase but also during the operational phase, direct faunal impacts are a concern of the development. Monitoring during the construction phase should be used to ensure that human-animal interactions are kept to a minimum and during the operational phase to assess the extent to which animal populations are vulnerable to or recover from the negative effects of the development.

  - The traffic on the access and service roads poses a significant risk to many animals, particularly during the construction phase when traffic volumes on the roads are likely to be heavy. Any fauna accidentally killed during construction or maintenance activities should be reported and a log of such mortalities maintained. Where possible the species killed should be identified and recorded as well. Monitoring should be on an ad-hoc basis, as incidents occur.
  - The activities of construction staff should be monitored to ensure that undesirable activities such as hunting, illegal collecting of plants, seeds or any other biological material does not occur, and that fires outside of the designated and demarcated areas do not occur. Any incidents or transgressions relating to these aspects should be logged, as well as the remedial steps taken to rectify the situation.
  - It is recommended that pre-construction surveys of Grey Rhebok and Klipspringer should be conducted by suitably qualified individual/s, in order to ascertain a baseline of the species distribution and abundance at the site. This should be followed up by post-construction surveys to ascertain the extent and nature of the impact on this species. Surveys should continue for a number of years (2-3) post-construction to ascertain the extent to which the short-term impacts which are likely to occur, persist in the longer-term as animals become habituated to the turbines. The surveys could be conducted seasonally as habitat preference of the animals may change depending on the season.
  - As part of mitigation, monitoring studies on potentially vulnerable species or groups of species such as tortoises, by students or universities could be encouraged and funded. There is a general paucity of knowledge on the ecological impacts of renewable energy facilities in South Africa and better knowledge will enable improved understanding of the nature of impacts as well as improve mitigation strategies.

3.4 Operational Phase

Birds and bats are likely to be impacted during the operational phase of the Witberg Wind Farm, primarily through collisions with the wind turbines or electrocutions with existing power lines. This section describes the monitoring measures to be undertaken during the operational phase of the Witberg Wind Farm. The monitoring requirements presented here may be modified based on the results of pre-construction monitoring and should therefore be regarded as provisional.

3.4.1 Ecological Monitoring (excluding Birds and Bats)

During the operational phase, monitoring should be focused on ensuring that that there are no unacceptable residual impacts such as soil erosion and alien plant invasion resulting from the construction phase, and on reducing the day to day impact of the Witberg Wind Farm.

Operational monitoring can be undertaken by the ECO on a monthly basis throughout the first year after construction (or more frequently after storm or extended rainfall events to check for erosion). After the first year, monitoring of rehabilitation measures could be checked twice annually for the next two years, and thereafter construction monitoring could be restricted to annual checks.

Specific aspects to be monitored during operation by the ECO would include:

- Disturbance of sensitive habitat during maintenance:
  Habitat damage caused by movement of vehicles and equipment during turbine or infrastructure maintenance activities.

- Erosion
  As erosion has been identified as one of the major risks associated with the development, there should be strong focus on monitoring the development, presence and persistence of erosion at the site. Specific recommendations include:

  - An erosion monitoring system is set in place to record the location and extent of all erosion sites in the vicinity of the roads and wind turbines. The results should be recorded and stored in manner that they can be used in a GIS.
  - The erosion monitoring system should record the measures taken to address existing erosion problems, their success and the occurrence of new erosion sites.
  - Sweeps specifically for erosion problems should be made after large storms or heavy rainfall events as these are likely to be the trigger events for erosion and control will be more easily affected while the problem is still of a small extent and low severity.
  - Sweeps should be more frequent in the first year of construction as this is when the majority of problems are likely to manifest as the soil will still be loose and unvegetated. Particular attention should be paid to roads and other disturbed areas on slopes or vulnerable soil types.
  - In terms of frequency, erosion should be checked at least quarterly, more often in the rainy season.

- Alien Plant Invasion
  The large amount of disturbance at the site is likely to render it highly vulnerable to alien plant invasion, particularly in the first few years post-construction. The roads and disturbed areas around the turbines are likely to be the major invasion foci. Monitoring for aliens should include the following:

  - In a similar manner to erosion, an alien monitoring system should be set up which allows for the occurrence, persistence and treatment of alien plants to be monitored in a manner which allows the data to be interrogated in a GIS.

- Monitoring for alien plants could be done simultaneously with erosion monitoring and at a similar interval.
- The system should record the species present, their location, the control measures used and their success rate.

3.4.2 Bat Monitoring

~~The degree and type of post-construction monitoring will be dependent on pre-construction monitoring programme results.~~

~~Identifying spatial patterns of bat fatalities among turbines within a facility is important for developing mitigation strategies to reduce or eliminate fatalities. For example, if fatalities are concentrated at specific turbines, then turbine specific mitigation strategies, such as curtailment, removal, or relocating the turbine, may reduce bat fatalities; however, if fatalities are broadly distributed, then facility-wide mitigation strategies must be considered.~~

Post-construction monitoring of bat communities must be undertaken in accordance with the relevant conditions of the environmental authorisation and the latest applicable bat monitoring guidelines.

3.4.3 Bird Monitoring

~~The primary aims of long-term bird monitoring during the operational phase of the Wind Farm are similar to those of the pre-construction monitoring (see *Section 3.2.3*). In addition, monitoring during the operational phase seeks to register and as far as possible document the circumstances surrounding all avian collisions with the turbines for at least a full calendar year after the facility becomes operational.~~

- ~~Avian densities~~

  ~~A set of at least 10 walk-transect routes, each of at least 1000 m in length, should be established in areas representative of all the avian habitats present within a 10 km radius of the centre of the Witberg site. Each of these should be walked at least 6-12 months after the wind farm is commissioned. The transects should be walked after 06h00 and before 09h00, and the species, number and perpendicular distance from the transect line of all birds seen should be recorded for subsequent analysis and comparison.~~

  ~~In addition:~~

  - ~~The cliff-lines within or close to the development area should be surveyed for cliff-nesting raptors at least every six months using documented protocols (Malan 2009).~~
  - ~~Known large eagle nest sites should also be checked twice annually for signs of occupation and breeding activity.~~
  - ~~All sightings of key species (*Table 6.1* of *Annex G* of EIR) on site should be carefully plotted and documented.~~

- ~~Bird activity monitoring~~

  ~~Monitoring of bird activity in the vicinity of the Wind Farm should be done over a 2-3 day period at least once per quarter for a full calendar year starting at least six months after the Wind Farm is commissioned. Each monitoring day should involve:~~

- Half-day counts of all priority species flying over or past the wind energy facility impact area; and
- Opportunistic surveys of cranes (and bustards) and raptors seen when travelling around the Witberg site.

- Passage Rates of Priority Bird Species

  Counts of bird traffic over and around the operational wind farm should be conducted from suitable vantage points (and a number of these should be selected and used to provide coverage of avian flights in relation to all areas of the wind farm), and extend alternately from an hour before dawn to midday, or from midday to an hour after dusk, so that the equivalent of four full days of counts is completed each count period. This should provide an adequate (if minimal) sample of bird movements around the facility in relation to a representative cross-section of conditions and times of day, for all seasons of the year. Details regarding specific measures to be undertaken post construction are identical to those listed for monitoring of passage rates of priority bird species during the pre-construction phase as described in *Section 3.2* above.

- Avian collisions

  Collision monitoring should have two components: (i) experimental assessment of search efficiency and scavenging rates of bird carcasses on the site, and (ii) regular searches of the vicinity of the wind farm for collision casualties.

- Assessing search efficiency and scavenging rates

  The value of surveying the area for collision victims only holds if some measure of the accuracy of the survey method is developed (Morrison 2002). To do this, a sample of suitable bird carcasses (of similar size and colour to the priority species – e.g. Egyptian Goose *Alopochen aegyptiacus*, domestic waterfowl and pigeons) should be obtained and distributed randomly around the site without the knowledge of the surveyor, some time before the site is surveyed (e.g. Shaw *et al.* 2010a & b). This process should be repeated opportunistically (as and when suitable bird carcasses become available) for the first two months of the monitoring period, with the total number of carcasses not less than 20. The proportion of the carcasses located in surveys will indicate the relative efficiency of the survey method.

  Simultaneous to this process, the condition and presence of all the carcasses positioned on the site should be monitored throughout the initial two-month period, to determine the rates at which carcasses are scavenged from the area, or decay to the point that they are no longer obvious to the surveyor. This should provide an indication of scavenge rate that should inform subsequent survey work for collision victims, particularly in terms of the frequency of surveys required to maximize survey efficiency and/or the extent to which estimates of collision frequency should be adjusted to account for scavenge rate (Osborn *et al.* 2000, Morrison 2002). Scavenger numbers and activity in the area may vary seasonally so, ideally, scavenge and decomposition rates should be measured twice during the monitoring year, once in winter and once in summer.

- Collision victim surveys

  The area within a radius of at least 50 m of the outer arc of the blades of each of the turbines at the facility should be checked regularly for bird casualties (Anderson *et al.* 1999, Morrison 2002). The frequency of these surveys should be informed by assessments of scavenge and decomposition rates conducted in the initial stages of the monitoring period (see above), but they should be done at least weekly for the first two months of the study, and surveys should commence as soon as possible after

~~construction is completed. The area around each turbine, or a larger area encompassing the entire WEF, should be divided into quadrants, and each should be carefully and methodically searched for any sign of a bird collision incident (carcasses, dismembered body parts, scattered feathers, injured birds). All suspected collision incidents should be comprehensively documented, detailing the precise location (a GPS reading), date and time at which the evidence was found, and the site of the find should be photographed with all the evidence *in situ*. All physical evidence should then be collected, bagged and carefully labelled, and refrigerated or frozen to await further examination. If any injured birds are recovered, each should be contained in a suitably-sized cardboard box. The local conservation authority (in this case CapeNature, failing this inform the monitoring project specialist) should be notified and requested to transport casualties to the nearest reputable veterinary clinic or wild animal/bird rehabilitation centre. In such cases, the immediate area of the recovery should be searched for evidence of impact with the turbine blades, and any such evidence should be fully documented (as above).~~

Post-construction bird monitoring must be undertaken in accordance with the relevant conditions of the environmental authorisation and the latest applicable bird monitoring guidelines for wind energy facilities. The post-construction bird monitoring must also be flexible and adopt an Adaptive Management Approach, in which changes can be implemented within a maximum of 3-4 weeks. In accordance with the Adaptive Management Plan, appropriate mitigation measures, such as curtailment at specific environmental conditions or during high-risk periods must be implemented where required (i.e. post construction monitoring shows 1 Red Data species killed at these turbines per year, then the use of appropriate automatic shut down or deterrent technology will have to be implemented in the case of mortality of Red Data species [defined as: 1 Red Data species killed per year]). The operational monitoring study design must determine the turbines that require appropriate mitigation measures.

3.4.4 Climatic Effects Monitoring

The potential impacts of wind farms on regional and local climatic conditions are presently poorly understood and little scientific research has been conducted in this regard. Modelling studies on the cumulative climatic effects of wind farms are inconclusive. Research suggests that wind farms have the potential to alter local-scale climatic conditions, and temperature in particular (Baidya Roy and Traiteur, 2010). It is reported that wind turbines and resulting changes to air flow patterns can alter local surface air temperatures, which may in turn alter local patterns of evaporation.

The potential significance of micro-climatic effects due to wind farms is currently unclear and further research is required to understand ecosystem level effects. In such a study, the following aspects should be considered within an integrated research programme; microclimatic changes, insect and pollination effects and other trophic level effects. It is recommended that such a study be coordinated by a research institute with support from the government and wind farm developers, such as the Project Company. In order to contribute to longer term understanding of ecosystem effects of wind farms it is recommended that certain climatic data such as evaporation, temperature, rainfall etc. yet to be defined, should be collected on site and at a control site to assist with interpreting additional data that is collected.

4 MITIGATION AND COMPLIANCE MONITORING MEASURES

Mitigation and compliance monitoring measures required to be undertaken by the Project Company or the Contractor, are presented in this section under the following headings:

- Pre-Construction Planning Phase;
- Construction Phase;
- Rehabilitation; ~~and~~
- Operational Phase; and
- Decommissioning Phase.

Mitigation and compliance monitoring measures listed in this section must be implemented during the various phases of the project. These measures are based on best practice and specialist recommendations to minimise impacts on the Witberg site.

A separate document, containing Contractor Compliance Standards has been drafted (Section 5) in order to clearly identify the roles and responsibilities of contractors appointed during the various phases of the project. These standards should be included as part of the contract documentation between the Project Company and the contractor, and the Project Company is responsible for ensuring the Contractor Compliance Standards are fully implemented by the contractor.

4.1 Pre-construction Planning Phase

In order to ensure compliance with environmental legislation and best practice guidelines the following actions are applicable to the pre-construction planning phase for the wind farm. The persons responsible for implementation of the actions are listed in the table below, the majority of which are the responsibility of the Project Company.

Key activities during the pre-construction planning phase will include:

- Pre-construction monitoring (see *Section 3.2*);
- Micro-siting of the turbines based on geotechnical and detailed site checks by archaeologist and ecologist (*Section 4.1*);
- Notification of DEA of any changes to the final turbine layout and additional mitigation / management measures, where needed;
- Drafting of subsidiary plans, policies and procedures;
- Developing with the contractor the following:
  - A Site Layout Plan
  - Method Statements

These activities are described in more detail in the matrix below. In terms of the requirements of the EIA Regulations (2014), as amended, this table includes a description of the aspect of the environment requiring management, the impact management objective, actions to be implemented to manage expected impacts and monitoring requirements.

PRE-CONSTRUCTION PLANNING PHASE

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
1.	Stakeholder engagement	Notify all registered Interested and Affected Parties of Environmental Authorisation.	1.1	Notify all registered I&APs and key stakeholders of the Environmental Authorisation opportunity and appeal procedure.	Notices sent to relevant parties on the stakeholder database. List of those to whom it was sent on file	Applicant	Within 14 days from the issuing of the Environmental Authorisation.
2	Permit Requirements	Ensure compliance with legal and other permitting requirements.	2.1	Ensure that all relevant legal requirements have been met.	Permits	Project Company	Prior to construction
3	Finalisation of EMP and Contractor Compliance Standards	Update EMP with EA conditions and other mitigation measures from monitoring	3.1	Incorporate additional mitigation measures specified by DEA in the EA into the EMP and Contractor Compliance Standards.	EMPr and Contractor Compliance Standards	Project Company	Prior to construction
4	Notification to DEA: Director of Compliance Monitoring	Ensure that DEA are notified of commencement date.	4.1	Notify DEA prior to commencement of construction.	Proof of communication.	Project Company	14-days in advance of commencement of construction or as required by DEA.
		Keep DEA informed of any aspects of non-compliance with EMP or EA	4.2	Notify DEA with reasons if any provisions of the EMP or EA cannot be implemented, and provide alternative	DEA notification	Project Company	Prior to construction
		Keep DEA informed of current contact details of applicant	4.3	Notify DEA of any change of contact details of the applicant	DEA notification	Project Company	Prior to construction
		Provide Site Layout Plan to DEA	4.4	Submit the detailed Site Layout Plan (see section 5.1 below) to DEA prior to construction	DEA notification	Project Company	Prior to construction
		Keep DEA informed of contact details of ECO	4.5	Submit the name and contact details of the appointed ECO prior to construction	DEA notification	Project Company	Prior to construction
		Submit copies of all permits to DEA	4.6	Copies of all permits and written approvals obtained by relevant authorities (as required) should be submitted to DEA and shall include but not necessarily limited to: • Removal of protected plants			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				• Non-interference with aerodrome communications (from SACAA) • Permit to transport abnormal loads (Road Traffic Act) • Approval from SAHRA relating to disturbance of heritage features			
5.	Site Layout Plan	Ensure detailed site layout minimises environmental and social risks and complies with EMP	5.1	Prepare a detailed Site Layout Plan that demarcates the following: • Turbine positions, lay down areas, cables, substation locations, roads, etc • Borrow pits, spoil heaps, cut and fill areas • No Go areas, including sensitive features such as ridges, drainage lines, vegetation patches • Stormwater drainage measures • Waste disposal and storage areas • Offices, works areas and ablutions • Cement/concrete batching • Storage of materials and equipment • Vehicle maintenance and storage	Final Site Layout Plan	Project Company	Prior to construction
6.	Subsidiary plans	Develop Subsidiary Plans to minimises environmental and social risks	6.1	The following subsidiary plans will be required prior to construction: • Health and Safety Plan • Traffic Management Plan • Transport Study • HIV Policy and Awareness Plan • Rehabilitation Plan • Policy for assessing all damages and losses • Community Development Trust • Recruitment Policy • Procurement Policy	Subsidiary plans	Project Company	Prior to construction

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				• Code of Conduct • Grievance Procedure These are referred to below, where relevant.			
7.	Health and Safety	Ensure the health and safety of site personnel during construction.	7.1 7.2	A Health and Safety Plan must be developed prior to the commencement of construction to identify and avoid work related accidents. This shall include: • Safety zones from residences, roads, right of way • Buffer zone to minimise electromagnetic interference with communication (eg microwave, radio and television transmissions) • Chemical ablution facilities • Final no-objection letter from the South African Civil Aviation Authority that the wind farm will not interfere with the performance of aerodrome radio Communication, Navigation and Surveillance equipment. Such approval must be submitted to the Director of Environmental Impact Evaluation. Turbines must be spaced in accordance with minimum standards for minimising safety risks in compliance with turbine manufacturers requirements	Health and Safety Documentation Final Site Layout Plan Final no-objection letter from Civil Aviation Authority Final Site Layout Plan	Project Company	Prior to construction
8	Socio-Economic Impact: Community	Enhance benefits associated with the Community	8.1	Establish a Community Development Trust for the advancement of local development needs; specifically at the	Community Development Trust	Project Company	Prior to and during operation.

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
	Development	Development Trust		farm and local municipality levels.			
			8.2	Project Company to contribute ~~up to four percent of after-tax profit~~ to the Trusts.			
			8.3	Projects would be identified in collaboration with the land owner and its farm workers to improve their general living conditions and access to better living standards.			
			8.4	Projects will be identified in collaboration with the local Municipality and community representatives to ensure alignment with the key needs identified through the Integrated Development Planning process.			
			8.5	Ensure projects are aligned with the Project Company's policies.			
9	Procurement of Services and Tender Procedures	Ensure that procurement of local, regional and national services is maximised	9.1	Establish a procurement policy which sets reasonable targets for the procurement of goods and services from South African residents /suppliers, particularly local residents as far as possible.	Procurement policy	Project Company	Prior to construction
			9.2	Procurement should advertise tenders in local and national newspapers.	Local and national advertisements		
			9.3	Procurement processes should identify and invite bids from local suppliers.	Invited bids from local suppliers		
			9.4	Adopt transparent adjudication			

Aspect #	Description of Aspect	Objective	#	Commitment / Actions Required / Key Controls	Parameters for Monitoring	Responsibility	Frequency / Timing
				process for local suppliers.	Demonstrate transparent process of adjudicating tenders		
10.	Employment & Recruitment	Ensure that employment of local people is maximised	10.1	Work closely with relevant local authorities, community representatives and organisations to ensure that the use of local labour and is maximised and stipulate this as part of contractor's contract.	Meeting minutes	Project Company	Prior to construction
			10.2	All skill requirements to be communicated to the local communities via appointed people prior to the commencement of the construction phase.	Meeting minutes / advertisements		
			10.3	Work closely with the wind turbine suppliers to provide the requisite training to the workers.	Training material and records of training		
			10.4	Ensure that the appointed project contractors and suppliers have access to Health, Safety, Environmental and Quality training as required by the project.			
11.	Social Ills and disruption	To limit, where possible, social ills brought about by the construction and operation of the renewable energy facility	11.1	Develop an induction programme, including a Code of Conduct, for all workers.	Code of Conduct	Project Company	Prior to construction
			11.2	All workers will agree to the Code of Conduct and be aware that contravention of the Code could lead to dismissal.	Code of Conduct		
			11.3	A grievance procedure will be established whereby complaints are	Grievance Procedure		

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				recorded and responded to.	HIV Policy		
			11.4	A HIV Policy and Awareness Plan must be developed and implemented.			
			11.5	Ensure contractor does not undertake recruitment to be done at the project site (to avoid workers camping and queuing at the site)			
12.	Disruption to and loss of agricultural land	Minimise disruption to agricultural activities and loss of agricultural land	12.1	All directly affected and neighbouring farmers will be able to lodge grievances with the Project Company using the Grievance Procedure.	Code of Conduct Grievance Procedure	Project Company	Prior to construction
			12.2	The Project Company to design the infrastructure layout in a manner that limits the footprint of the facility and all associated infrastructure.			
			12.3	The Project Company to plan construction activities to minimise disruption of farming practices, e.g. notifying farmers in advance of site clearance to allow prior harvesting for instance.	Final Site Layout Plan		
13.	Property Prices and Desirability of Property	Minimise the negative impacts on property prices.	13.1	Design site layout in a manner that limits the footprint of the facility and all associated infrastructure.	Final Site Layout Plan	Project Company	Prior to construction
			13.2	Prepare a site Rehabilitation Plan that will be implemented post construction and as part of the decommissioning phase.	Rehabilitation Plan Grievance Procedure		
			13.3	All directly affected and neighbouring farmers will be able to lodge			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				grievances with the Project Company using the Grievance Procedure.			
14.	Traffic Impact	Minimise negative effects associated with the increase in traffic.	14.1	A Transport Study must be undertaken at least one year prior to construction to determine the most appropriate route from port to site.	Transport Study	Project Company	Prior to construction
			14.2	Project Company will develop a Traffic Management Plan including strict controls over driver training, vehicle maintenance, speed restrictions, appropriate road safety signage, and vehicle loading and maintenance measures.	Traffic Management Plan		
			14.3	The Project Company will develop a policy and procedure for assessing all damages and losses (e.g. damage to property, injury or death of people or livestock) resulting from project vehicles.	Policy		
			14.4	All necessary transportation permits will be applied for at this stage and obtained from the relevant authorities, including permits for abnormal loads. Oversee development of permits required by contractors.	Permits		
15.	Damage or Destruction of Cultural Heritage Interests	Avoid damage or destruction of cultural heritage aspects	15.1	A field survey must be undertaken by an archaeology and cultural heritage specialist, informing the micro-siting of turbines in the final layout design prior to construction.	Final Site Layout Plan	Project Company	Prior to construction
			15.2	A policy of minimal intervention should be adopted. Abandoned buildings			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				must be made no-go areas for construction crews.			
			15.3	Although some roads would require upgrading, the re-use of existing farm tracks is desirable.	Photographs and ECO report		
			15.4	Heritage sites 012-015 (buildings) contain fittings that are potentially valuable. These fittings must be inventoried and photographed *in-situ*, and then removed under supervision of an archaeologist, and under a permit from Heritage Western Cape to a place of safety.	Approval from heritage and planning authorities		
			15.5	Any use of buildings of heritage value and identified in the heritage report contained in the EIA will be subject to approval by heritage and planning authorities.			
16.	Waste and effluent	Prevent soil and/or groundwater contamination from waste and effluent.	16.1	A suitable area for waste skips must be selected, away from water courses, and included in the site layout plan.	Waste Management Plan	Project Company	Prior to construction
			16.2	Waste skips are to be covered as far as possible to limit the occurrence of wind-blown litter.			
17.	Soil compaction and erosion	Minimise soil compaction and erosion	17.1	Roads should be upgraded where possible and only essential roads should be built e.g. between turbines.	Final Site Layout Plan	Project Company	Prior to construction
18.	Loss of Vegetation	Minimise impacts associated with vegetation loss	18.1	Contract an ecologist to undertake pre-construction walk-through assessments to confirm presence of unique or priority species of concern in	Appropriate contractor for monitoring	Project Company	Prior to construction

Aspect #	Description of Aspect	Objective	#	Commitment / Actions Required / Key Controls	Parameters for Monitoring	Responsibility	Frequency / Timing
				the development footprint (see *Section 3*).	Final Site Layout Plan		
			18.2	Avoid placement of turbines in areas of High or Very High Sensitivity, or in areas where significant impacts on listed or priority species may arise			
			18.3	Define and select a road alignment that minimises impacts on areas classified as Very High Sensitivity. In addition, the preferred road alignment should be assessed by a botanist before construction to ensure that rare, protected or endangered species are not impacted by the road and any alternative deviations or routes are identified.			
			18.4	Laydown areas and other infrastructure requirements should be minimised and sites selected with the assistance of a botanist to ensure they are sited in areas with lowest conservation value and/or where listed species are absent.			
			18.5	Given the presence of the Critically Endangered *Protea convexa* in the area, the area directly impacted by the final project layout and in particular, the planned access roads which traverse the north-facing slope, should be surveyed by a botanist when the final site layout plans are available to ensure that populations of			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				this species are not impacted.			
			18.6	Undertake botanical surveys during pre-construction planning to confirm the feasibility of search and rescue of rare plant species that may occur in the wind farm footprint, and the identification of areas earmarked for construction disturbance containing plants that can be relocated and used for rehabilitation			
			18.7	Vegetation clearing prior and during construction must be limited to the footprint of the proposed development.	Appropriate contractor for monitoring		
		Minimise vegetation impacts related to location and use of borrow pits	18.7	Alternative sources of aggregate should be considered and should include the option of sourcing aggregate from nearby borrow pits (of similar soil and vegetation type ie quartzite) in preference to opening new quarries on the Witberg. Consideration should be given to the option of several smaller borrow pits versus one or two large ones. The primary goal should be to use as much rock material from turbine foundations in preference to opening new borrow pits and to limit the quantity required from new borrow pits.		Project Company	Prior to construction
			18.8	Where importing aggregate is not feasible, several borrow pit locations should be selected based on the technical requirements of the project			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				and an appropriately qualified botanist/ecologist should visit the sites to assess the site options.			
			18.9	Borrow pit sites should be carefully selected to avoid rare edaphic habitats such as quartz or gravel patches which often contain rare dwarf succulents.			
			18.10	Due to the large difference in geology between the lower slopes of the Witberg and the ridges, it is recommended that aggregate is sourced locally from a matching substrate. In particular, it is strongly recommended that shale or mudstone aggregate should not be used on the ridges and that quartzite should be used where this is the natural substrate to avoid invasion by alien plant species.			
19.	Faunal Impacts	Minimise impacts to onsite fauna	19.1	Design planning must minimise habitat loss (indicated in Section 18) to reduce impacts to fauna.	Final Site Layout Plan	Project Company	Prior to construction
			19.2	Consideration could be given to liaising with research institutions to undertake long-term monitoring of fauna (see *Section 3*).	Appropriate contractor for monitoring		
20.	Disturbance of bat habitat and collision	Mitigate the potential impact on bats	20.1	Keep road development and off-road vehicle use to a minimum and upgrade existing roads rather than developing new road infrastructure.	Final Site Layout	Project Company	Prior to construction
			20.2	Minimise blasting requirements and			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				coordinate blasting events to minimise the number of events required.			
			20.3	All project infrastructure, i.e. turbines, substation and masts etc, should be located away from water bodies, cave roosts or any areas considered to be of high bat conservation importance that may be found during pre-construction monitoring.			
			20.4	Avoid the placement of turbines in the valleys between the ridges.			
			20.5	Bat specialist appointed to undertake pre-construction long-term monitoring (see *Section 3*).	Appropriate contractor for monitoring		
			20.6	Correct turbine placement out of high sensitivity buffers.			
21.	Disturbance of avifauna habitat and collision	Mitigate the potential impact on avifauna	21.1	Bird specialist appointed to undertake pre- and post-construction long-term monitoring (see *Section 3*).	Final turbines selected	Project Company	Prior to construction
			21.2	On-site demarcation of 'no-go' areas should be identified during pre-construction monitoring to minimise disturbance impacts associated with the construction of the facility			
			21.3	Restrict development from particularly sensitive areas and avoid placement of turbines within 1500m of known Verreaux's Eagle nests; 2500m of Martial Eagle nests, and 1500m of the centre of the dam on the western			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				border to avoid displacement and/or collision (as discussed in more detail in Section 8.2 of the EIR)			
			21.4	Avoiding all nest areas and foraging/roosting areas of Red Data species in the siting of said facilities, guided by the CRM and known flight paths. Given the increased likelihood of eagle fatalities due to the taller turbines, buffers around nests must be maintained at the 1.5-km no-go buffer recommended in the Verreaux's Eagles guidelines (Ralston-Paton 2017);			
			21.5	Restrict development from any other important nest sites, foraging areas or flyways of priority species that may be identified during pre-construction monitoring			
			21.6	~~Burying all transmission lines between turbines underground (as proposed); and~~ Increasing visibility of transmission line from the substation to the Eskom grid			
			21.7	The bird specialist should assess the need for additional mitigation measures based on pre-construction monitoring results. These measures should be agreed by the relevant parties including DEA, the ornithologist and the developer.			
			21.8	For all new overhead power lines to be			

Aspect #	Description of Aspect	Objective	Actions #	Commitment / Actions Required / Key Controls	Parameters for Monitoring	Responsibility	Frequency / Timing
				fitted with diurnal and nocturnal bird diverters / anti-collision devices to reduce collisions and burying all internal power lines in the WEF, wherever that is possible.			
			21.9	The shortest possible route from the wind farm to the existing power line be taken to reduce fatalities.			
			21.10	The turbines closest to the known eagle nests are moved to at least 1.5-km away.			
22.	Visual Impacts	Minimise visual impacts	22.1	Maintain a visual buffer zone of 4 km for the wind turbines along the N1 National Road, in accordance with the revised layout ~~Layout Alternative 3~~	Final Site Layout Plan and building designs	Project Company	Prior to commencement of construction.
			22.2	Adhere to the 500 m visual buffer for the wind turbines from district roads. This mitigation has been adopted in the 25-turbine layout			
			22.3	Adhere to a 500 m visual buffer, but preferably 1km, from the N1 for the substation and operations and maintenance buildings. This has been achieved in the 25-turbine layout			
			22.4	On-site infrastructure should be grouped together as far as possible			
			22.5	The substation and other infrastructure on top of the Witberg Ridge should be designed for maximal visual screening, and landscaping should soften the			

Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				visual impact.			
			22.6	The design of the buildings must be compatible in scale and form with buildings of the surrounding area, preferably using the regional Karoo architectural style. All yards and storage areas to be enclosed by masonry walls;			
			22.7	Signage related to the enterprise must be discrete and confined to the entrance gates. No other corporate or advertising signage, particularly billboards, will be permitted; and			
			22.8	All navigation lights on the wind turbines should be fitted with reflectors so that the lights are not visible from below.			

4.2 Construction Phase

In order to ensure compliance with environmental legislation requirements and NEMA best practice the following actions are applicable to the construction phase and are the responsibility of the Project Company. Standard construction phase compliance standards that need to be implemented by the contractor are contained in Section 5. In terms of the requirements of the EIA Regulation s(2014), as amended, this table below includes a description of the aspect of the environment requiring management, the impact management objective, actions to be implemented to manage expected impacts and monitoring requirements.

CONSTRUCTION PHASE							
Activity		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Activity**		**#**	**Commitment / Actions Required / Key Controls**			
1.	Compliance with EMP and EA	Confirm the Project Company's commitment to adherence to EMPr and Contractor Compliance Standards	1.1	Ensure that the EMPr; Contractor Compliance Standards and EA are available at the site throughout construction and implemented by the contactor.	Copy of signed EMPr and EA with subcontractor	Project Company Contractor	Prior to construction
		Auditing of compliance with EMPr and Environmental Authorisation	1.2 1.3	An audit report must be undertaken by an independent auditor at the end of the construction and rehabilitation phase, and shall be submitted to DEA. The audit report shall indicate the date of the audit, name of auditor; and outcome of audit in terms of compliance with the environmental authorisation and conditions of the EMPr.	Audit report and proof of submission to DEA	Project Company	End of Construction and rehabilitation phase
2.	Health and Safety	Ensure the health and safety of subcontractors and site users	2.1 2.2 2.3	A Health and Safety Plan must be developed prior to the commencement of construction to identify and avoid work related accidents. This plan must be adhered to by the appointed construction contractors and meet Occupational Health and Safety Act (OHSAct), Act 85 of 1993, requirements. Potentially hazardous areas must be clearly demarcated (i.e. unattended foundation excavations).	Signed Health and Safety Plan Signage	Project Company Contractor	During construction

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				Appropriate Personal Protective Equipment (PPE) must be worn by all construction personnel. This shall include the use of ear protection in areas where the 8-hour ambient noise levels exceed 75dBA.	Signed Health and Safety Plan		
			2.4	Wind turbine technology must as far as possible limit the amount of noise produced by the turbines.	Optimal turbine design		
3.	Dust and emissions	Limit fugitive dust and exhaust emissions	3.1 3.2	Dust abatement should be implemented especially during windy conditions and in areas prone to generation of airborne dust. This shall include spraying of water and covering of stockpiled and transported materials. Due to the crippling drought experienced in the Western Cape, this Directorate recommends that only non-potable water be used for dust suppression purposes.	ECO records Grievance procedure documentation/logbook	Contractor	During construction
			3.3	Vehicles travelling on unpaved or gravel roads must not exceed a speed of 40 km/hr.			
			3.4	Stockpiles of dusty materials must be enclosed or covered by suitable shade cloth or netting to prevent escape of dust during loading and transfer from site.			
			3.5	Vehicles are to be kept in good working order and serviced regularly to minimise emissions.			
			3.6	All directly affected and neighbouring farmers and local residents must be able to lodge grievances with G the Project Company 7 using the Grievance Procedure regarding dust emissions that could be linked to the project.			
			3.7	The cleared areas must be stabilised immediately to control dust.			
				The generation of dust must comply with the National			

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				Dust Control Regulations (GN No. R. 827 of 1 November 2013), promulgated in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) ("NEM:AQA").			
4.	Noise pollution	Avoid disturbing surrounding land-users	4.1 4.2	Vehicles must to adhere to speed limits on site, and not exceed 40km/hr A grievance procedure will be established whereby complaints are recorded and responded to.	Signage on site Grievance procedure logbook	Contractor	During construction
5.	Vegetation loss	Prevent unnecessary disturbance and damage to natural vegetation and topsoil loss	5.1 5.2 5.3 5.4	Minimise extent of vegetation clearing to absolute minimum and only to the Footprint of the WEF, and demarcate areas of sensitive vegetation as no-go areas during construction. Exclude construction activities from areas mapped as Very High Sensitivity, as well as wetlands and drainage lines, quartz and gravel patches and rock pavements (small areas (10's of meters) of flat rock-sheet) that are found to contain rare and endemic species). These areas should also be considered as No-Go areas. Roads which must traverse drainage lines should be built in a manner which does not disrupt the natural flow of water in the drainage line and also does not promote bank erosion. Revegetation of road verges on steep slopes, temporary lay down areas and other impacted areas is strongly recommended and should be undertaken in accordance with a Rehabilitation Plan. However, any rehabilitation that takes place should be restricted to transplanting plants from areas that will be permanently lost into areas that need to be rehabilitated or protected from erosion. No plants should be brought onto the site	Onsite observation and record Plant Search and Rescue Plan Revegetation and Rehabilitation Plan	Contractor	During construction

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				for rehabilitation purposes. Such measures would also reduce the fragmentation effects of the development and encourage the natural spread of fires at the site.			
			5.5	Furthermore, given the undifferentiated nature of the shallow soils on the ridge, the potential for natural revegetation of borrow pits should be maximised by back-filling them with natural rock and soil, contouring appropriately to avoid steep slopes, and revegetating with plants removed from other construction areas on the Witberg ridge.			
			5.6	Where unique plants are found with potential for translocation the ECO or botanist should liaise with Kirstenbosch Gardens or other nurseries to investigate the potential of translocating some species into horticultural collections or collecting seed of some of the rare or uncommon species.			
			5.7	Educate all contractors as to the importance of the undisturbed conservations areas and prohibitions on fires, and collection of plant material.			
			5.8	Concurrent rehabilitation and alien vegetation control is to be undertaken in all sensitive areas.			
			5.9	Vegetation clearance should preferably be phased as work is required in certain areas, as opposed to clearance of the entirety of the site at once. If this is not practical, and the entire site will be cleared at the start of the contract.			
			5.10	Wherever possible, indigenous vegetation should be trimmed rather than cleared.			
			5.11	Cleared vegetation is not allowed to be dumped			

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				anywhere, other than at an approved waste disposal facility or at an area agreed to by the environmental control officer.			
			5.12	Wherever possible and where the material is suitable, vegetation should be chipped for later use as mulch in landscaped areas or for stabilisation purposes; or it should be taken to a green waste/ compost facility for compost production.			
			5.13	Invasive alien plants that are removed from the site should not be chipped for mulch if they are in a seed-bearing stage to prevent further distribution of alien plant seeds. Such material should be disposed of at a suitable waste disposal facility. Wherever possible, suitable larger stumps should be made available to the local community for further use.			
6.	Traffic Impact	Mitigate traffic impacts	6.1	The traffic management plan will be adhered to including adherence to speed limits and 'rules of the road'.	Traffic Management Plan	Contractor	During construction
			6.2	During construction, arrangements and routes for abnormal loads must be agreed in advanced with the relevant authorities and the appropriate permit must be obtained for the use of public roads.			
			6.3	Schedule delivery of turbines outside of peak traffic hours.			
			6.4	Notify affected farm owners of date and time of turbine delivery to minimise effects on farm activities.	Proof of notification of farmers		
			6.5	All directly affected and neighbouring farmers and local residents will be able to lodge grievances with the Project Company using the Grievance Procedure regarding dangerous driving or other traffic violations that could be	Grievance Procedure		

CONSTRUCTION PHASE							
Activity		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Activity**		**#**	**Commitment / Actions Required / Key Controls**			
				linked to the project.			
			6.6	During construction, if abnormal loads are required for maintenance, the appropriate arrangements will be made to obtain the necessary transportation permits and the route agreed with the relevant authorities to minimise the impact of other road users.	Permits		
7.	Damage or Destruction of Cultural Heritage Interests	Minimise damage to cultural heritage interests	7.1	Cuttings for the access roads should be inspected by a suitably qualified palaeontologist, as it would be an economical transect for representative sampling.	ECO records and photographs	Contractor Specialist	Prior to and throughout construction
			7.2	Trenches and excavations should be inspected by a palaeontologist and a report submitted to HWC.			
			7.3	Any substantial excavations, such as borrow pits opened for road making, providing material for berms, footings of turbines or any other construction, similarly need to be checked by a qualified palaeontologist for material of potential scientific importance.			
			7.4	Should any human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to Heritage Western Cape and/or SAHRA as required and the appropriate process followed.	ECO records and HWC/SAHRA response		
			7.5	A policy of minimal intervention should be adopted. Abandoned buildings must be made no-go areas for construction crews.			
8.	Socio-cultural issues	Minimize impacts associated with influx of jobseekers.	8.1	The Project Company code of conduct developed prior to the construction phase must be adhered to.	Code of conduct must be available on site.	Contractor	During construction
			8.2	The HIV Policy and Awareness Plan developed prior to the commencement of construction must be adhered to by	HIV policy must be available on site.		

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				the Project Company employees.			
			8.3	The construction workers (from outside the area) should be allowed to return home over the weekends or on a regular basis to visit their families; the contractor should make the necessary arrangement to facilitate these visits.	ECO records		
9.	Faunal Impacts	Mitigate impacts on fauna	9.1	Poaching or hunting should be strictly forbidden and control poaching by banning dogs on site and enclosing worker compounds.	ECO records and photographic evidence	Contractor	During construction
			9.2	Fauna must have 'right of way' on the roads. Slow moving animals such as tortoises which may be in the way, should be placed at the side of the road in the direction the animal was seen travelling.			
			9.3	All vehicles must stick to designated and prepared roads and a speed limit (up to 40 km/hr – lower for heavy vehicles) must be enforced.	Road signage, ECO records & grievance logs		
			9.4	No harvesting or collecting of plants, seeds, animals or their parts to be allowed.	Worker training & awareness records		
			9.5	No fires must be allowed at the site, other than within demarcated areas within a defined camp area with adequate provision for fire control.			
			9.6	No dogs or other pets allowed at the site.			
			9.7	All staff at the site to remain within the compound at night.			
			9.8	Poaching or hunting must be strictly forbidden.			
			9.9	The construction camp and other temporary storage areas must be fenced-off to reduce human-wildlife			

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
			  9.10	interactions. It should be mandatory for staff of the Project Company to attend an environmental briefing and training session with respect to the guidelines outlined in this EMPr.	Training material and records of training		
10.	Bird Habitat Loss: Destruction, Disturbance and Displacement	Minimise disturbance to birds	10.1 10.2 10.3 10.4 10.5	Containing the construction footprint to a bare minimum, and similarly maintaining noise disturbance to a minimum – the latter with particular reference to blasting on the ridge-top associated with foundation excavations. Ideally, blasting should not be conducted during the breeding seasons of affected priority species and the number of blasting events required should be minimized by synchronizing multiple, neighbouring blasts into as few events as possible Avoid disturbing Red Data birds around wind farms during construction by not constructing within 1000-m of Verreaux's Eagle nests or Booted Eagle nest during their early breeding season (May – June) or small-chick rearing season (June – July). For breeding Booted Eagles, the seasons to avoid are August – September; Avoid blasting or causing noise disturbance in the early breeding season (May – June) or small-chick rearing season (June – July)seasons anywhere within 3-km of active nests for all Red Data species. Marking of all new overhead power lines with bird diverters and staggering pylons of adjacent lines to reduce large birds colliding with them.	ECO records Power line markings implemented	Contractor	During blasting
11	Bat Disturbance and Displacement	Minimise disturbance to birds	11.1	Blasting near identified bat areas should be minimised (if it cannot be avoided) during early summer (November/ December) during the peak breeding season and during the coldest winter months (June/ July/ August) when bats	ECO records	Project Company Contractor	Blasting

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				go into a state of prolonged torpor and may not be able to escape and disperse.		Specialist	
			11.2	Depending on the findings of pre-construction monitoring, the need for ultrasonic deterrent devices may need to be considered			
			11.3	If any caves with substantial bat roosts are identified during pre-construction monitoring works, a buffer of at least 500m should be maintained around the caves, with little or no development occurring within this buffer;			
			11.4	Utilise lights with wavelengths that attract less insects (low thermal/infrared signature), such lights generally have a colour temperature of 5000k (Kelvin) or more. If not required for safety or security purposes, lights should be switched off when not in use.	Lighting implemented		
			11.5	Keep to designated areas when storing building materials, resources, turbine components and/or construction vehicles and keep to designated roads with all construction vehicles. Damaged areas not required after construction should be rehabilitated by an experienced vegetation succession specialist.	Restriction of activities to designated areas		
12.	Visual Impacts	Minimise visual impacts	12.1	The construction camp, material stores and lay-down area should be located as far as possible out of sight of the N1 and rail line.	Appropriate placement of construction camp	Project Company	Throughout construction
			12.2	The extent of the construction camp and stores should be limited in area to only that which is essential;			
			12.3	Disturbed areas rather than pristine or intact landscape areas should preferably be used for the construction camp.	Evidence in contract		

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
			12.4	Measures to control wastes and litter should be included in the contract specification documents;	specification documents.		
			12.5	Provision should be made for rehabilitation/ re-vegetation of areas damaged by construction activities and not required during operation of the wind farm.	Revegetation and rehabilitation plan Relevant permits in place		
			12.6	Borrow pits for the construction (which would be identified in the detailed civil engineering phase), would be subject to permits from the relevant authorities. Borrow pits on the site would be rehabilitated and re-vegetated according to the botanist's recommendations.			
13.	Waste and effluent	Minimise impacts due to waste and effluent production	13.1	All waste must be separated into skips for recycling, reuse and disposal.	Waste management plan	Project Company	Throughout construction
			13.2	Vegetative material must be kept on site and mulched after construction to be spread over the disturbed areas to enhance rehabilitation of the natural vegetation.	Waste manifest documents		
			13.3	Effluent from temporary staff facilities must be collected in storage tanks, which must be emptied by a sanitary contractor.			
			13.4	Effluent from concrete washings from the on-site batching plant must be contained within a bunded area.			
			13.5	All solid and liquid waste materials, including any contaminated soils, must be stored in a bunded area and disposed of by a licensed contractor.			
			13.6	Effluent and stormwater run-off must be discharged away from any water courses.			
			13.7	Steel off-cuts must be re-used or recycled, as far as possible.			

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
			13.8	Materials that cannot be re-used or recycled must be placed in a skip and removed from site to a licensed municipal disposal site.			
14.	Spoil Material	Reuse spoil material where possible and minimize the impacts of spoil material that cannot be reused.	14.1	A Spoil Management Plan (SMP) must be developed prior to the commencement of construction and implemented to identify and avoid spoil material related impacts.	Signed Spoil Management Plan	Project Company	During Construction
			14.2	The purpose of the SMP is to: • identify the environmental management issues associated with the sourcing, handling, transportation, stockpiling, disposal and reuse of spoil and fill material; • document and describe the systems and procedures developed to mitigate environmental impacts; and • ensure site personnel are aware of the environmental obligations and work procedures.			
			14.3	The objectives of the SMP are to: • establish procedures and criteria for spoil/fill material handling, transportation and movement, stockpiling, reuse and disposal; • protect the environment by preventing or minimising adverse impacts in relation to air quality, noise, contamination and local amenity; • ensure that appropriate environmental systems and controls are implemented during material management activities; • achieve sustainable use of resources by maximising the reuse of earthen materials generated on site; and • mitigation of environmental impacts of other road construction activities by prioritising the reuse of surplus spoil in ways that mitigate these other			

CONSTRUCTION PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				activities (e.g. use in noise mounds or to achieve flatter embankment batter slopes).			

4.3 Operational Phase

In order to ensure compliance with environmental legislation requirements and recommendations specified by specialists during the EIA process, the following generic and specific requirements are applicable during the operational phase of the Witberg Wind Farm. The operational mitigation and monitoring measures specified here provide a foundation for further development of the Operational EMPr.

OPERATIONAL PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
1.	Visual impacts	Minimize the visual impacts during the operation phase.	1.1 1.2 1.3 1.4	Signage related to the wind farm must be discrete and confined to entrance gates. No advertising will be permitted. Footprint of the facilities, as well as parking and vehicular circulation, should be clearly defined. Operations and maintenance areas should be screened by buildings, walls, hedges and/or tree planting, and should be kept in a tidy state. The navigation lights on the wind turbines should be fitted with reflectors.	Photographic evidence	Project Company	Throughout operation
2.	Health and Safety	Maintain health and safety standards	2.1 2.2	Regular maintenance of turbines and all other infrastructure must be undertaken to ensure optimal functioning and reducing the chance of gearbox failure. Regular inspections of the turbine foundations, towers, blades, spinners and nacelle must be undertaken in order to check for early signs structural fatigue.	Inspection records	Project Company	Throughout operation
3.	Dust and emissions	Limit fugitive dust and exhaust emissions.	3.1	Vehicles travelling on unpaved or gravel roads should not exceed a speed of 40 km/hr.	Signage	Project Company	Throughout operation
4.	Waste and Effluent	Prevent soil and groundwater pollution	4.1 4.2	Used oil stored on site must be stored in an impervious container, within a bunded area. General waste must be removed from site by a licensed contractor.	Appropriate storage areas in place Waste manifest documents	Project Company	Throughout operation

OPERATIONAL PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
			4.3	Areas disturbed during construction will be re-vegetated with indigenous vegetation to prevent erosion.	Photographic evidence; Revegetation and rehabilitation plan		
5.	Traffic	Minimise traffic impacts	5.1	During operation, if abnormal loads are required for maintenance, the appropriate arrangements will be made to obtain the necessary transportation permits and the route agreed with the relevant authorities to minimise the impact of other road users.	Permits	Project Company	Throughout operation
			5.2	All internal and access roads that will be used by the Project Company during the operational phase of the project will be maintained by the Project Company throughout the life of the project.	Inspection reports		
6.	Damage or Destruction of Cultural Heritage Interests	Minimise damage to cultural heritage interests	6.1	A policy of minimal intervention should be adopted. Abandoned buildings must be made no-go areas for workers.	Monitoring data	Project Company	Throughout operation
7.	Loss of Topsoil, Soil Compaction and Erosion	Minimise erosion	7.1	Long-term monitoring to be undertaken (see *Section 3*).	Monitoring reports and photographic evidence	Project Company	Biannually
			7.2	Temporary laydown areas will be re-vegetated with indigenous vegetation.			
			7.3	Erosion control measures should be initiated as soon as signs of erosion problems become apparent.			
			7.4	Should any erosion develop which cannot be remedied by simple erosion control measures, then the services of a rehabilitation and erosion control consultant with experience in semi-arid zones should be brought in to provide guidance.			
8.	Loss of Vegetation	Minimise impacts associated with loss of vegetation	8.1	Minimise requirement for vegetation clearing and soil disturbance	Audit reports and photographic evidence	Project Company	Throughout operation
			8.2	Since nutrient-poor soils are an important characteristic			

OPERATIONAL PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				of most fynbos soils, it is recommended that fill and construction material is sourced locally at the site and specifically that no shale or mudstone from below the ridges is used on the quartzite ridges. The use of a different substrate would inhibit natural vegetation recovery as well as facilitate the spread of alien plants at the site.			
			8.3	Natural re-vegetation of disturbed areas such as road verges should be encouraged. Seed of indigenous species collected on site could be used to revegetate cleared areas.			
			8.4	No foreign plant material should be brought onto the site, this specifically includes such items as hay bales.	Audit Reports		
			8.5	All alien plants observed at the site should be removed on a regular basis. Monitoring checks for alien plants and alien clearing if required should be conducted on a quarterly basis.			
			8.6	Alien species should be controlled in the appropriate manner as determined by a botanist as incorrect control measures can exacerbate invasion problems. Clearing methods should aim to keep disturbance at a minimum.			
			8.7	A Fire Management Policy and guidelines will be developed to ensure that the operation of the Wind Farm is compatible with the long-term fire ecology of the site.	Fire Management Policy		
9.	Fauna	Minimise impacts to fauna on site	9.1	Poaching or hunting should be strictly forbidden and control poaching by banning dogs on site and enclosing worker compounds.	Audit reports and photographic evidence	Project Company	Throughout operation
			9.2	Fauna must have 'right of way' on the roads. Slow			

OPERATIONAL PHASE							
Activity		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Activity**		**#**	**Commitment / Actions Required / Key Controls**			
				moving animals such as tortoises which may be in the way, should be placed at the side of the road in the direction the animal was seen travelling.			
			9.3	All vehicles must stick to designated and prepared roads and a speed limit (up to 40 km/hr) must be enforced.			
			9.4	No harvesting or collecting of plants, seeds, animals or their parts to be allowed.			
			9.5	It should be mandatory for staff of the Project Company to attend an environmental briefing and training session with respect to the guidelines outlined in this EMPr.	Training material and records of training		
10.	Bird Habitat Loss: Destruction, Disturbance and Displacement	Loss of habitat-minimise disturbance to birds	10.1	Minimizing the disturbance impacts associated with the operation of the facility, by scheduling maintenance activities to avoid disturbance in sensitive areas (identified during monitoring)	Maintenance schedules	Project Company	Throughout operation
11.	Birds: Avian collisions	Monitor potential injury to avifauna and fatalities	11.1	Implementing a rigorous monitoring programme (see *Section 3*) and findings of the proposed monitoring schedule, should be implemented.	Monitoring reports	Project Company	Initial 12 to 24 month period at which time whether or not additional monitoring is required.
			11.2	Lighting on the turbines to kept to a minimum (but in line with aviation regulations), and is coloured (red or green) and intermittent.	Inspection reports		
			11.3	Mitigations may be required as the turbines are erected. The following mitigations may be required if eagles change their flight patterns: • The use of a multi-sensor bird system; • The use of use of black-blade mitigation by painting one turbine blade black; • The use of intense short wavelength LED lights	Monitoring reports		
			11.4	Based on expert opinion of the threatened eagles at	Monitoring reports		

OPERATIONAL PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Activity		#	Commitment / Actions Required / Key Controls			
				Witberg the following mitigations are suggested: • Post-construction, all turbines killing one or more Red Data bird per year will need to be fitted either with (a) the highly effective black-blade mitigation; or its equivalent; or (b) automated multi-sensor deterrent or curtailment / shut-down systems; (c) Intense short-wave radiation (Foss et al. 2017) should also be tested as a deterrent; or (d) If audible or visual deterrence is ineffective then selective stopping of turbines should be tried.			
			11.5	The Developer must agree to follow the mitigation measures that may result from the operational monitoring and Adaptive Management Plan.			
				In accordance with the Adaptive Management Plan, appropriate mitigation measures, such as curtailment at specific environmental conditions or during high-risk periods (i.e. post construction monitoring shows 1 Red Data species killed at these turbines per year, then the use of appropriate automatic shut down or deterrent technology or any other mitigation measure deemed suitable will have to be implemented in the case of mortality of Red Data species [defined as: 1 Red Data species killed per year]).	Monitoring reports		
				The operational monitoring study design must determine the turbines that require appropriate mitigation measures.	Monitoring reports		
			11.6	Post-construction monitoring must effectively duplicate the baseline work, with the addition of surveys for collision and electrocution victims under the turbines and ancillary power infrastructure	Monitoring reports		
			11.7	Two adaptive management mitigations are			

OPERATIONAL PHASE							
Activity		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
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				recommended if Red Data species are found to be killed: 1. Investigate painting half a blade black to deter raptors, as undertaken by Norwegian wind farms to reduce white-tailed Eagle deaths with great success (Stokke et al. 2017). 2. Implement the automated "Multi-sensor" video system, presently under test by J Avni, which deters incoming birds or feathers the blades, or turns off turbines as collision-prone species approach within 500-m of these turbines.			
12.	Bat disturbance habitat loss	Limit loss of bat habitat	12.1	Maintenance activities should be kept within the immediate vicinity of the turbines and associated infrastructure.	Audit Report and photographic evidence	Project Company	
			12.2	A Site Maintenance and Rehabilitation Plan must be implemented to restore disturbed areas and maintain bat habitat.			
			12.3	Utilise lights with wavelengths that attract less insects (low thermal/infrared signature), such lights generally have a colour temperature of 5000k (Kelvin) or more. If not required for safety or security purposes, lights should be switched off when not in use or connected to standard passive infrared motion sensors.			
			12.4	Where needed curtailment or acoustic deterrents may also be implemented.	Implementation of curtailment or deterrents as required		
			12.5	Currently the most effective method of mitigation, after correct turbine placement, is alteration of blade speeds and cut-in speeds in environmental conditions favourable to bats. Mitigation should be applied during the peak activity periods and times, and when the advised wind speed and temperature ranges are			

<table>
<tr><th colspan="7">OPERATIONAL PHASE</th></tr>
<tr><th colspan="2">Activity</th><th rowspan="2">Objective</th><th colspan="2">Actions to be undertaken to Mitigate Environmental Impact</th><th rowspan="2">Parameters for Monitoring</th><th rowspan="2">Responsibility</th><th rowspan="2">Frequency / Timing</th></tr>
<tr><th>#</th><th>Description of Activity</th><th>#</th><th>Commitment / Actions Required / Key Controls</th></tr>
<tr><td></td><td></td><td></td><td></td><td>prevailing (considering conditions in which 80% of bat activity occurred). Both the temperature and wind speed parameters indicated in the table below must be present simultaneously to infer mitigation:
<table>
<tr><td></td><td>Applies to Turbines 11, 14, 15, 23</td></tr>
<tr><td>Spring peak activity (times to implement curtailment/ mitigation)</td><td>Based on monitoring station W2 60m data:
15 September - 15 October
Sunset – 00:00; and 5:00 – sunrise</td></tr>
<tr><td>Environmental conditions in which to implement curtailment/ mitigation</td><td>Below 5.5m/s measured at 60 height
Above 15.5°C measured at 60m height</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Autumn peak activity (times to implement curtailment/ mitigation)</td><td>Based on monitoring stations W3 10m and W4 60m data:
01 February to 15 May
Sunset – 00:00; and 5:00 – sunrise</td></tr>
<tr><td>Environmental conditions in which to implement curtailment/ mitigation</td><td>Below 8.5m/s measured at 60m
Above 18.5°C measured at 60m</td></tr>
</table>
A basic "6 levels of mitigation" (by blade manipulation or curtailment), from light to aggressive mitigation is presented below:
1. No curtailment (free-wheeling is unhindered below manufacturer's cut-in speed so all</td><td></td><td></td><td></td></tr>
</table>

OPERATIONAL PHASE							
Activity		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Activity**		**#**	**Commitment / Actions Required / Key Controls**			
				momentum is retained, thus normal operation). 2. Partial feathering (45-degree angle) of blades below manufacturer's cut-in speed in order to allow the free-wheeling blades half the speed it would have had without feathering (some momentum is retained below the cut-in speed). 3. Ninety-degree feathering of blades below manufacturer's cut-in speed so it is exactly parallel to the wind direction as to minimize free-wheeling blade rotation as much as possible without locking the blades. 4. Ninety-degree feathering of blades below manufacturer's cut-in speed, with partial feathering (45-degree angle) between the manufacturer's cut-in speed and mitigation cut-in conditions. 5. Ninety-degree feathering of blades below mitigation cut-in conditions. 6. Ninety-degree feathering throughout the entire night. It is recommended that curtailment initially start off at Level 3 during the dates, times and environmental conditions set out in the Table included in the bat amendment report dated 2018. Then depending on the results of the post construction mortality monitoring the curtailment can be either relaxed or intensified (moving down or up in the levels) up to a maximum intensity of Level 5. This is an adaptive mitigation management approach that will require changes in the mitigation plan to be implemented immediately and in real time during the post construction monitoring.			
13.	Bat collisions and barotrauma	Monitor fatalities	13.1 13.2	Long-term monitoring to be undertaken (see *Section 3*). A register must be maintained of injuries to bats,	Monitoring reports Register of collisions/ injured bat	Project Company	Initial 12 to 24 month period at which time whether

OPERATIONAL PHASE							
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			  13.3	complaints or queries received as well as any action taken. Undertake feasible mitigation measures identified informed by monitoring.	species Mitigation measures implemented		or not additional monitoring is required.
14.	Tourism Impacts	Enhance tourism impacts	14.1 14.2	Work with the Local Municipality and local tourism organisations to raise awareness about the wind farm. Information brochures and posters will be made available at the local libraries to provide more information about the wind farm. These should be presented in the appropriate languages to maximise the benefits.	Records of consultation	Project Company	Throughout operation
15.	Electromagnetic Interference	Prevent EMI effects	15.1 15.2	Should EMI be shown to be a problem, mitigation measures might include the replacement of receiving aerial installations, replacement by satellite dishes or the provision of a private transmitter. The Project Company has committed to correct any EMI problems should they be shown to be the cause of the wind farm.	Installation reports	Project Company	Throughout operation
16.	Shadow flicker	Assess potential shadow flicker impacts	16.1	A shadow flicker study will be undertaken if the final layout results in turbines being located within 10 blade diameters of any dwellings or buildings within which people work.	Shadow flicker study	Project Company	Throughout operation
17.	Notification of landowners	Inform landowners on maintenance activities	17.1	Landowners should be informed at least 48 hours in advance of scheduled maintenance activities to ensure that provision can be made to avoid conflicting land uses and to ensure access to the site (eg relocate grazing animals form the area)	Notification of landowners	Project Company	Prior to maintenance activities.

4.4 Decommissioning Phase

A detailed decommissioning and rehabilitation plan should be developed prior to decommissioning of the Wind Farm. This plan should include, but should not be limited to, conditions regarding removal of infrastructure, management of waste and/or contaminated soil, dust suppression and re-vegetation. As part of the decommissioning phase the Project Company will undertake the required permitting processes applicable at the time of decommissioning.

The relevant mitigation measures contained under the construction section should be applied during decommissioning and therefore are not repeated in this section.

4.5 Monitoring Programme

A monitoring programme must be in place during all phases of the project life cycle not only to ensure conformance with the EMPr, but also to monitor any environmental issues and impacts which have not been accounted for in the EMPr that are, or could result in significant environmental impacts for which corrective action is required. The aim of the monitoring and auditing process would be to monitor the implementation of the specified environmental specifications, in order to:

- Monitor and audit compliance with the prescriptive and procedural terms of the environmental specifications
- Ensure adequate and appropriate interventions to address non-compliance
- Ensure adequate and appropriate interventions to address environmental degradation
- Provide a mechanism for the lodging and resolution of public complaints
- Ensure appropriate and adequate record keeping related to environmental compliance
- Determine the effectiveness of the environmental specifications and recommend the requisite changes and updates based on audit outcomes, in order to enhance the efficacy of environmental management on site
- Aid in communication and feedback to authorities and stakeholders

All documentation e.g. audit/monitoring/compliance reports and notifications, required to be submitted to the DEA in terms of the Environmental Authorisation, must be submitted to the Director: Compliance Monitoring of the Department.

Records relating to monitoring and auditing must be kept on site and made available for inspection to any relevant and competent authority in respect of this development.

5 GENERAL CONTRACTOR COMPLIANCE STANDARDS

The following Contractor Compliance Standards have been drafted for use by any Contractors appointed by the Project Company during the construction of the Witberg Wind Farm. Guidelines for Contractors developed for the Cape Metropolitan Council by Ninham Shand (2002) and relevant to the expected construction phase of wind farm were extracted and modified as the basis for this schedule of Contractor Compliance Standards. The Contractor appointed will use these as a basis for guiding all construction activities. The Project Company will retain overall responsibility during all stages of any construction activity and ensure that all construction activities are in compliance with the EMP. The contractors shall with due care and diligence execute and complete the works in accordance with the provisions of the Contractor Compliance Standards and any other requirements set out by the Project Company.

Identification of targets helps to identify the desired outcome of implementing the management measure can assist in deriving an audit report.

As far as possible, the contractor compliance standards are set out in accordance with the following phasing, typical of a construction project:

- Pre-Construction Planning;
- Construction; and
- Post-Construction.

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
1.	EMP and Contractor Compliance Standards legally binding on contractor	Contractor compliance with EMP	1.1	Contractor requirement to implement the EMP and Contractor Compliance Standards is legally binding through the contract with <u>the Project Company</u>. Contractor to keep copy of EMP and Contractor Compliance Standards on site and to provide ECO with a copy.	EMPr provisions relevant to contractor	Contractor	Prior to construction
2.	General Environmental Protection-Method Statements	Contractor activities comply with approved method statements to minimise impacts to the environment	2.1	The contractor shall prepare the following method statements: • **Access routes**: Location of proposed access routes, rehabilitation of temporary access routes • **Blasting (if required)**: details of all methods and logistics • **Camp establishment**: layout and preparation; method of installing fences for no go areas; working areas and construction camp areas • **Cement/concrete batching (if applicable)**: Location, layout, and preparation of cement/concrete batching facilities including methods employed for mixing concrete and management of run-off water • **Contaminated water**: including containment of runoff and disposal of polluted water • **Dust control methods** • **Clearance of vegetation**: method during site establishment • **Earthworks**: method for control of erosion during bulk earthwork operations, and method of undertaking earthworks, including hand excavation and spoil management • **Emergency**: response to possible emergencies on site • **Environmental awareness**: logistics for environmental awareness for contractors' employees and management staff • **Fire and hazardous substances**: handling and storage of hazardous wastes; emergency spillage procedures and compounds to be used; emergency procedures for fire; use of herbicides and other poisonous substances;	Method statements	Contractor	Prior to construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				• **Fire and fuel spills**: methods of refuelling vehicles; methods for cleaning up fuel spills; refuelling of construction vehicles • **Rehabilitation**: methods for disturbed areas, and revegetation after construction is complete • **Solid waste management**: solid waste control and removal of waste from the site • **Sources of material**: details of materials to be imported to the site • **Traffic safety measures**: entry and exit off public roads			
3.	Health and Safety	Ensure the health and safety of site personnel during construction.	3.1 3.2	A Health and Safety Plan developed by the Project Company must be adhered to. Buffer zones around roads, houses, and any other structures must be observed.	Health and Safety Documentation and Method Statements Final Site Layout Plan	Project Company and Contractor	Prior to construction
4.	Construction site layout plan	General environmental protection	4.1	The contractor shall provide input into the Site Layout Plan to be presented to the DEA by the Project Company for approval prior to starting construction activities. This plan shall take account of provisions of the EMP and this Contractor Compliance Standards and shall demarcate the different works areas including: • Turbine positions, lay down areas, cables, substation locations, roads, etc. • All buildings and structures including: contractors' camp and lay down areas, site offices, laboratory, fuel stores, toilets and ablutions, construction materials stores, vehicle and equipment stores, wash bays and solid waste storage and disposal sites • Works areas such as batching plants (if required) • Roads and access routes • Gates and fences • Essential services (permanent and temporary water, electricity and sewage and substation) • Rubble and waste rock storage and disposal sites • Firebreaks • Excavations and trenches, borrow pits, rubble and waste rock storage and disposal sites and topsoil	Layout plan shows different work areas. Plan approved by DEA	Contractor and ECO	Prior to construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				stockpiles. • Features and plants to be conserved. • No Go areas (e.g. ecological sensitive areas, and cultural heritage site)			
5.	Procurement and Tender	Ensure that procurement of local, regional and national services is maximised:	5.1 5.2 5.3 5.4	Establish a Procurement Policy which sets reasonable targets for the procurement of goods and services from South African residents /suppliers, particularly local residents as far as possible. Procurement should advertise tenders in local and national newspapers. Procurement processes should identify and invite bids from local suppliers. Adopt transparent adjudication process for local suppliers.	Procurement Policy Local and national advertisements Invited bids from local suppliers Demonstrate transparent process of adjudicating tenders	Contractor	Throughout construction
6.	Employment & Recruitment	Ensure that employment of local people is maximised	6.1 6.2 6.3 6.4	No employment will take place at the entrance to the site. Only formal channels for employment will be used. All skill requirements to be communicated to the local communities via appointed people prior to the commencement of the construction phase. Work closely with the wind turbine suppliers to provide the requisite training to the workers. Ensure that the appointed project contractors and suppliers have access to Health, Safety, Environmental and Quality training as required by the project.	Recruitment Policy Evidence of recruitment Training material and records of training	Contractor	Prior to construction
7.	Good community relations	Minimise raised expectations in local community and limit social disruption	7.1 7.2	Information boards: containing background information on the construction activity and the relevant contact details for complaints shall be erected near the entrance to the site. Notification of onset of construction: Notify Employer, relevant authorities and local community in writing as well	Large info board erected at the site and correct information provided (contact details) Proof of notification of onset of construction	Contractor	Prior to construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
			    7.3	as verbally of the onset of construction activities, including contact details for complaints. Community liaison assistants to inform the local community members of the recruitment process and onset of construction and schedule.	to the Project Company, relevant authorities and local community Recruitment records of community liaison assistance		
8.	Social Ills and disruption	To limit, where possible, social ills brought about by the construction and operation of the renewable energy facility	8.1 8.2	Develop an induction programme, including a Code of Conduct, for all workers. All workers will agree to the Code of Conduct and be aware that contravention of the Code could lead to dismissal. HIV Policy and Awareness Plan developed by the Project Company must be adhered to.	Code of Conduct HIV Policy and Awareness Plan	Contractor	Prior to construction
9.	Traffic Impact	Minimise negative effects associated with the increase in traffic.	9.1	All necessary transportation permits will be applied for at this stage and obtained from the relevant authorities, including permits for abnormal loads.	Permits	Contractor	Prior to construction
10.	Damage or Destruction of Cultural Heritage Interests	Avoid damage or destruction of cultural heritage aspects	10.1 10.2	Construction work must not commence until turbines have been micro-sited and final positions are fixed and checked by an archaeologist and approval given to go-ahead Adhere to buffers around sensitive features set out in the EMP.	Archaeological study and approval	Contractor	Prior to construction
11.	Waste and effluent	Prevent soil and/or groundwater contamination from waste and effluent.	11.1	A suitable area for waste skips must be selected, away from water courses, and included in the site layout plan.	Waste Management Plan	Contractor	Prior to construction
12.	Loss of Vegetation	Minimise impacts associated with vegetation loss	12.1 12.2 12.3	Ensure that infrastructure and construction activities are confined to previously disturbed areas as far as possible. Avoid the development of new roads where possible to minimise impact to natural vegetation. Temporary construction lay-down areas should be sited on croplands, preferably in flat areas. No natural vegetation	Final Site Layout Plan	Contractor	Prior to construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				should be transformed for temporary activities.			
			12.4	Restricting service roads and underground cabling for the turbines to previously disturbed lands, avoiding natural vegetation.			
			12.6	Areas containing *Protea convexa* should be avoided, but where not possible, individuals should be relocated within the site.			
			12.7	Prior to construction, the exact layout of the turbines and associated lay-down areas must be inspected by an ecologist and if necessary adjusted to avoid unnecessary impact.			
13.	Faunal Impacts	Minimise impacts to onsite fauna	13.1	Measures to minimise habitat loss listed above should be implemented to minimise impacts to fauna.	As above	Contractor	Prior to construction
14.	Bat Habitat Loss: Destruction, Disturbance and Displacement	Mitigate impacts on bats	14.1	Install passive ultrasonic recorders for bats designed for long-term outdoor usage.	Monitoring data	Contractor	Prior to construction
			14.2	Identify spatial patterns of bat fatalities among turbines.	Monitoring data		
			14.3	Keep road development to a minimum where possible, upgrade existing roads rather than developing new road infrastructure.	Final Site Layout Plan		
			14.4	Project infrastructure to be located away from waterways, known cave roosts or any areas considered to be of bat conservation importance specifically identified bat sensitive areas in the EIR.	Final Site Layout Plan		

CONSTRUCTION PHASE							
Activity		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Activity**		**#**	**Commitment / Actions Required / Key Controls**			
1.	Compliance with EMP	Confirm contractor's commitment to adherence to EMP.	1.1	Ensure that the EMP and Environmental Authorisation are available at the site during installation.	Copy of signed EMP and Environmental Authorisation.	Contractor	Outset of construction
			1.2	Ensure that equipment is in place to meet EMP			

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
			  1.3	requirements and Contractor Compliance Standards. Signed commitment from subcontractors to compliance with EMP and Contractor Compliance Standards.	Checklist of EMP requirements Copy of signed EMP with subcontractor		
2.	Health and Safety	Ensure the health and safety of subcontractors and site users	2.1 2.2 2.3 2.4	A Health and Safety Plan developed by the Project Company must be adhered to by the appointed construction contractors and meet Occupational Health and Safety Act (OHSAct), Act 85 of 1993, requirements. Potentially hazardous areas must be clearly demarcated (i.e. unattended foundation excavations). Appropriate PPE must be worn by all construction personnel. No smoking to be allowed near the fuel storage area and notices depicting "No Smoking", "No Naked Lights" and "Danger" to be erected at the fuel storage site.	Signed Health and Safety Plan Signage ECO Reports Signed Health and Safety Plan	Contractor ECO Contractor	During construction
3.	General environmental damage	Environmental awareness training of workers	3.1 3.2 3.3 3.4	The contractor will be required to employ a full-time ECO at the construction site until rehabilitation is complete. The contractor or his representative (e.g. ECO) shall provide training and guidance to site workers before commencing work on relevant components of the EMP, including any new site workers taken on during the course of work. Workers shall understand the dos and don'ts of working on the site and controls on causing environmental damage. This should include notification of regulations on harvesting wild fauna and flora from the surrounding area, damage to cultural heritage, littering, use of formal latrines, sexual engagement with locals, etc. Information posters should be put up in worker eating areas depicting typical prohibited activities that should be complied with on and off site.	ECO on site full-time Proof of training of workers / Signed attendance register Information posters displayed in social areas on site	ECO Contractor	Prior to construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
4.	Construction area maintenance	General Environmental Protection	4.1 4.2 4.3	Construction area to be kept neat and clean at all times. Refuse and waste storage to be positioned away from buildings. Drip trays to be inspected and emptied daily and closely monitored during rain events.	Camp clean and neat Refuse stored away from buildings Drip trays emptied daily & monitored	Contractor	During construction
5.	Access roads	General environmental protection and control of nuisances	5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10	Access to the site and works area shall use existing roads or tracks wherever possible. Induction and training shall include the use of permitted roads and highlight prohibition of making new tracks. All temporary access roads shall be rehabilitated to the satisfaction of the Engineer. Erect and maintain marker pegs or painted stones along the boundaries of work areas, access roads or tracks to prevent unauthorised movement outside designated areas. Mud and sand deposited onto public roads shall be cleared regularly. Upgrading of access roads should limit activities as far as possible within the existing confines of the road Implement dust control measures where windblown dust can create a nuisance. The contractor shall repair any damage caused to the existing access road as a result of construction activities. Install and maintain appropriate traffic warning signs. Trained and equipped flagmen shall be used in the event that construction activities (e.g. delivery of abnormal loads) may create a traffic hazard on public roads.	ECO Report Proof of training of workers / Signed attendance register ECO Report Site pegged and marked Site well maintained Deviations of road alignment avoided Dust control implemented & no grievances noted No damage visible and any damage repaired Traffic warning signs Flagmen contracted	Contractor and appointed engineer	During construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
					for turbine delivery		
6.	Fencing and site access	Minimise impacts to human health and safety	6.1 6.2 6.3	Access to the site should be off-limits to the public at all times. Fencing shall be maintained throughout construction. Temporary fencing shall be removed and loose wire removed from the site.	Site suitably fenced Public access restricted.	Contractor	Throughout construction
7.	Fire protection	Fire prevention.	7.1 7.2 7.3 7.4	No fires are allowed around the construction area. Adequate firefighting equipment must be available on site and maintained in good working order. Welding, gas cutting or cutting of metal will only be permitted in an area designated as safe by the contractor. Smoke free areas should be declared and appropriate signage erected.	Adequate firefighting equipment with the contractor Appropriate signage	Contractor	During construction
8.	Damage or Destruction of Cultural Heritage Interests	Minimise damage to cultural heritage interests	8.1 8.2 8.3 8.4 8.5 8.6	Ensure that trenches and excavations are checked by a palaeontologist. No turbines located in areas of high sensitivity. Heritage Western Cape to be notified immediately if burial/human remains are uncovered during the construction of the wind farm. Workers access to the koppie and the old farmhouse should be forbidden in order to minimise vandalism. Apply all mitigation measures to reduce the noise and visual impacts as presented in *Chapters 11* and *12* of the EIR. The construction activities will be undertaken in accordance with a schedule that will be developed by the Project Company and approved by the landowners.	ECO reports Final turbine micro-siting Minutes/ communications ECO reports Construction schedule	Palaeontologist Contractor	Prior to and throughout construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
9.	Refuse, waste (refers to all solid waste, including installation debris, timber, cans etc.) and effluent	Limit the potential for site pollution and the accumulation of waste materials on site. Prevent soil and/or groundwater contamination from waste and effluent.	9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8 9.9	Minimise, reduce, reuse and recycle waste material where possible. All waste must be separated into clearly marked skips for recycling, reuse and disposal. Steel off-cuts will be re-used or recycled, as far as possible. Vegetative material will be kept on site and mulched after construction to be spread over the disturbed areas to enhance rehabilitation of the natural vegetation. All solid and liquid waste that cannot be reused or recycled will be placed in a skip and must be removed off site and disposed of at a licensed municipal disposal site. Any hazardous waste must be removed by a licensed waste disposal operator. Disposal of any waste and/or construction debris by burning or burying to be forbidden. The skips shall be kept in a sheltered place and covered to prevent contents blowing out. Effluent and stormwater run-off will be discharged away from any water courses (e.g. drainage lines). Effluent from construction site offices and staff facilities will be collected in storage tanks, which will be removed by a licensed sanitary contractor. Effluent from the batching plant (if applicable) will be contained within a bunded area and not be allowed to drain into water courses. Effluent will be recycled or removed. Effluent from temporary staff facilities will be collected in storage tanks, which will be emptied by a sanitary contractor.	Waste manifest documents Relevant documentation for waste disposal must be prepared and filed (e.g. certificates of safe disposal). Visual inspection of site- ECO Report.	Contractor	Throughout construction
10.	Solid waste management	Limit the potential for site pollution and the	10.1	The contractor shall set up a solid waste control and removal system in accordance with the Waste Method	ECO Reports	Contractor and ECO	During construction

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
		accumulation of waste materials on site.		Statement.			
			10.2	Bins shall be emptied on a daily basis and shall not be left in an overflowing state.			
			10.3	Waste and litter shall be disposed of in scavenger and weatherproof bins stored in a fenced and covered area.			
			10.4	Waste shall be collected and removed from the site at least once a week			
			10.5	Hazardous waste to be separated from general waste stream.			
			10.6	Waste disposed of in suitable landfill site to be confirmed and approved by the regulatory authority.			
			10.7	Workers must clean up the contractor's camp and work areas once a week.			
			10.8	If recycling facilities available, the contractor is encouraged to separate waste into glass, paper and tins and dispose of these at recycling depots.			
			10.9	No waste, including plastic waste, is to be burned on site			
11.	Pollution controls from ablution facilities	Minimise environmental impacts from toilet facilities for temporary workers	11.1	Adequate ablution facilities must be provided for staff.	Adequate toilets provided with toilet paper	Contractor and ECO	During construction
			11.2	Excretion or urination will be prohibited other than at provided facilities.	Site layout plan		
			11.3	Facilities for washing hands to be provided as part of or immediately next to all toilet facilities.	Toilets kept clean and no sign of sewage spills		
			11.4	Toilet facilities to be situated at least 50m away from water courses or drainage lines.			
			11.5	Discharge of waste from toilets and burial of waste is			

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				strictly prohibited.			
			11.6	Ensure no spillage occurs when toilets cleaned or emptied.			
			11.7	Portable toilets shall be properly secured to prevent toppling in wind.			
			11.8	At least 1 toilet per 20 workers to be provided.			
			11.9	Toilets to be maintained in hygienic state and serviced and emptied regularly. Toilet paper to be provided.			
12.	Concrete Works	Prevent contamination of soil and groundwater through management of concrete	12.1	If concrete is to be batched on site the following measures apply:	Waste documentation and visual inspection of site- ECO Report	Contractor	During construction
			12.2	Excess or spilled concrete or aggregate to be confined within the work area and then removed to a licensed landfill site.			
			12.3	Concrete to be mixed on mortar boards or in bunded area, away from drainage channels and water courses.			
			12.4	Visible remains of the mixing of concrete, either solid or from washings, to be physically removed and disposed of as waste at a licensed landfill site.			
13.	Earthworks	Minimise impact of earthworks on general environment	13.1	All earthworks shall be undertaken in such a manner so as to minimise the extent of any impacts caused by such activities and shall be limited to demarcated areas.	ECO Report	Contractor and appointed engineer	During construction
			13.2	No earthworks equipment shall be allowed outside demarcated areas unless permitted by the engineer.			
14.	Impact on Surface and Groundwater	Minimise impacts on surface and groundwater	14.1	Soil stockpiles will be protected from wind or water erosion through placement, vegetation or appropriate covering.	Site inspection and photographic evidence	Contractor	Throughout construction phase
			14.2	Proper drainage controls such as culverts, cut-off trenches will be used to ensure proper management of surface water runoff to prevent erosion.			

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
			14.3	Cleared or disturbed areas will be rehabilitated as soon as possible to prevent erosion.			
			14.4	Fuel, oil and used oil storage areas will have appropriate secondary containment (ie bunds).			
			14.5	Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of to a licensed landfill by a licensed operator.			
			14.6	Construction vehicles and equipment will be serviced regularly and provided with drip trays, if required.			
			14.7	Workshop areas will be lined to prevent subsurface ingress of contaminants and drainage from these areas will not be allowed to drain into water courses.			
			14.8	Works including foundations for the turbine and substation will be a minimum of 20 m from any watercourse.			
15.	Loss of Topsoil, Soil Compaction and Erosion	Minimise erosion and loss of topsoil	15.1	Restrict removal of vegetation and soil cover to the development footprint.	Site inspection and photographic evidence- ECO Report	Contractor	Throughout construction phase
			15.2	Implement soil conservation measures such as stockpiling top soil for remediation of disturbed areas. Topsoil storage should be as brief as possible and rehabilitation areas must be fenced off to protect plants until plant communities are adequately developed.			
			15.3	Proper drainage controls such as culverts, cut-off trenches will be used to ensure proper management of surface water runoff to prevent erosion.			
			15.4	Soil stockpiles should be vegetated or appropriated covered to reduce soil loss as a result of wind or water to prevent erosion.			
			15.5	Disturbed areas will be rehabilitated as soon as possible to			

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				prevent erosion.			
			15.6	Construction vehicles will remain on designated and prepared roads.			
			15.7	Work areas will be clearly defined and demarcated to avoid unnecessary disturbance of areas outside the development footprint.			
			15.8	Construction vehicles will remain on designated and prepared roads.			
16.	Dust and emissions	Limit fugitive dust and exhaust emissions.	16.1	Vehicles travelling on gravel roads should not exceed a speed of 40km/hr.	Site inspections	Contractor	During construction
			16.2	Where appropriate, dust abatement measures should be implemented to restrict airborne dust, especially during windy conditions.			
			16.3	Containers for dusty materials will be enclosed or covered by suitable tarpaulins / nets to prevent escape of dust during loading and transfer from site.			
			16.4	Where necessary, stock piles of soil must be covered by suitable shade cloth or netting to prevent erosion, fugitive dust and to prevent the escape of dust during loading and transfer from site.	Service records.		
			16.5	Vehicles are too kept in good working order and serviced regularly to minimise emissions.	Grievance procedure documentation/logbook		
			16.6	Any complaints received from neighbours or site users must be reported to the Project Manager and measures must be taken to limit dust.			
17.	Noise pollution	Avoid disturbing surrounding land-users.	17.1	Vehicles and equipment used on site must be in good condition and serviced regularly.	Service and maintenance records for equipment and vehicles. ECO Report	Contractor	During construction
			17.2	Mechanical equipment with lower sound power levels must be selected to ensure that permissible occupation			

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				noise-rating limit of 85 dBA is not exceeded.			
			17.3	Construction workers and personnel must wear hearing protection equipment when the 8-hour ambient noise levels exceed 75dBA.			
			17.4	Vehicles must to adhere to speed limits on site, and not exceed 40km/hr.	Signage on site		
18.	Vegetation loss	Prevent unnecessary disturbance and damage to natural vegetation and topsoil loss.	18.1	Subcontractors are to use existing roads and tracks as far as possible and construction vehicles must stick to the designated and prepared roads.	Photographic evidence ECO report	Contractor	Throughout construction
			18.2	Topsoil must be set aside to facilitate re-vegetation.	Site inspection		
			18.3	No vegetation should be collected for fire wood or other uses.			
			18.4	During construction in areas classified as high sensitivity areas, a botanist or ecologist will be consulted to ensure micro-siting of turbines minimises damage to or loss of sensitive flora.	Final Site Layout Plan	Ecologist or botanist Project Company	
			18.5	Clear demarcation during the construction phase of all undisturbed sensitive areas that are not within the direct footprint of the wind farm to ensure that there is no uncontrolled access by construction vehicles and labourers.	Signage	Contractor	
			18.6	Rehabilitation or ecological restoration during and after the construction phase will be undertaken with indigenous plants with input from a botanist with experience in restoration of semi- arid areas.	Rehabilitation reports	Contractor	
			18.7	Remove alien vegetation from disturbed areas.	ECO Report	Contractor Ecologist	
			18.8	Distribution of the unusual Aloe species encountered at the site should be mapped and all individuals treated with caution until such time as its identity can be confirmed.			

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		**Objective**	**Actions to be undertaken to Mitigate Environmental Impact**		**Parameters for Monitoring**	**Responsibility**	**Frequency / Timing**
#	**Description of Aspect**		**#**	**Commitment / Actions Required / Key Controls**			
				Until the identity of the species is confirmed, the species and habitats should be removed or impacted. Should the Aloe prove to be a previously unknown species, then the area where the species is found to occur should receive an increased level of conservation protection.			
			18.9	Borrow pits, if required, should be constructed in previously disturbed areas and restricted to areas of quartzite rather than the sandstone-dominated areas to the southeast of the site;			
			18.10	Soil disturbance should be kept to an absolute minimum.			
			18.11	Where vegetation loss will occur before construction a qualified botanist is to ensure that rare, protected or endangered species are not being impacted by the road and if necessary, identify alternative routes or relocate plants to a similar nearby environment.	Training attendance records		
			18.12	All contractors must undertake training provided by the Project Company to educate them on the importance of the undisturbed conservations areas.			
19.	Bird Habitat Loss Destruction, Disturbance and Displacement	Minimise impacts on birds	19.1	Habitat loss and disturbance can be mitigated during the construction phase by on-site demarcation of 'no-go' areas. These areas should be identified during pre-construction monitoring.	Photographic evidence ECO Report	Contractor	Throughout construction
20.	Bat Habitat Loss: Destruction, Disturbance and Displacement	Mitigate impacts on bats	20.1	Minimise blasting requirements and coordinate blasting events to minimise number of events required.	Site Layout Plan	Contractor	Throughout construction
			20.2	Caution should be taken to ensure construction footprints are kept to an absolute minimum, including storage of materials, stockpiling etc.	Site Layout Plan		
			20.3	Construction activities should be avoided as far as possible during early summer (November to February) when it is peak bat breeding season and young bats may not be able to leave the roost.	ECO Report		

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
			20.4	Construction activities (particularly blasting) should be minimised during the coldest winter months (June/ July/ August), when bats go into a state of prolonged torpor and may not be able to escape the roost.			
			20.5	Should any caves be identified on site during pre-construction bat monitoring, a buffer of at least 500 m should be implemented around such as cave, with no development occurring within this buffer zone	Monitoring records		
21.	Traffic Impact	Mitigate traffic impacts	21.1	The Traffic Management Plan will be adhered to including adherence to speed limits and 'rules of the road'.	Traffic Management Plan and ECO reports	Contractor	During construction
22.	Socio-cultural issues: Influx of job seekers	Minimize impacts associated with influx of jobseekers and labour. .	22.1	The code of conduct and HIV Policy developed by the Project Company must form part of contractual agreement and must be adhered to.	Code of conduct and HIV policy must be available on site.	Contractor	During construction
			22.2	No recruitment of workers shall be permitted at the site	Employment records	Contractor	During construction
			22.3	The construction workers (from outside the area) should be allowed to return home over the weekends or on a regular basis to visit their families; the contractor should make the necessary arrangement to facilitate these visits.	Employment records	Contractor	During construction
23.	Loss of Agricultural Land	Minimise loss to agricultural land	23.1	Ensure compliance with construction plans and worker 'Code of Conduct' developed by the Project Company.	Photographic evidence and ECO report	Contractor	During construction
			23.2	Any damage to vegetation will be rehabilitated in accordance with mitigation proposed for the rehabilitation of natural vegetation.			
			23.3	Ensure that the gates are closed at all times and that any damage to the infrastructure is repaired immediately or compensated for.			
			23.4	Animals will be able to continue grazing on the land between the wind turbines; the area should be treated as one of the grazing camps.			
			23.5	Any damage to vegetation will be rehabilitated in			

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				accordance with mitigation proposed for the rehabilitation of natural vegetation.			
24.	Faunal Impacts	Mitigate impacts on fauna	24.1	During construction in areas classified as high sensitivity areas, an ecologist should be consulted to ensure micro-siting of turbines minimises damage to or loss of sensitive habitat.;	ECO reports and photographic evidence	Ecologist	During construction
			24.2	Clear demarcation during the construction phase of all undisturbed sensitive areas that are not within the direct footprint of the wind energy facility to ensure that there is no uncontrolled access by construction vehicles and labourers.		Contractor	
			24.3	All vehicles must stick to designated and prepared roads.			
			24.4	Temporary construction lay-down or assembly areas should be sited on transformed areas.			
			24.5	Rapid regeneration of plant cover must be encouraged by setting aside topsoil during earthmoving and replacing onto areas where the re-establishment of plant cover is desirable to prevent erosion.			
			24.6	Control poaching by banning dogs on site and enclosing worker compounds.			
			24.7	Fauna must have 'right of way' on the roads. Slow moving animals such as tortoises which may be in the way, should be placed at the side of the road in the direction the animal was seen travelling.			
			24.8	All vehicles must stick to designated and prepared roads and a speed limit (up to 40 km/hr) must be enforced.			
			24.9	No fires should be allowed at the site anywhere other than within demarcated areas within the compound.			
			24.10	No dogs or other pets belonging to the contractor should			

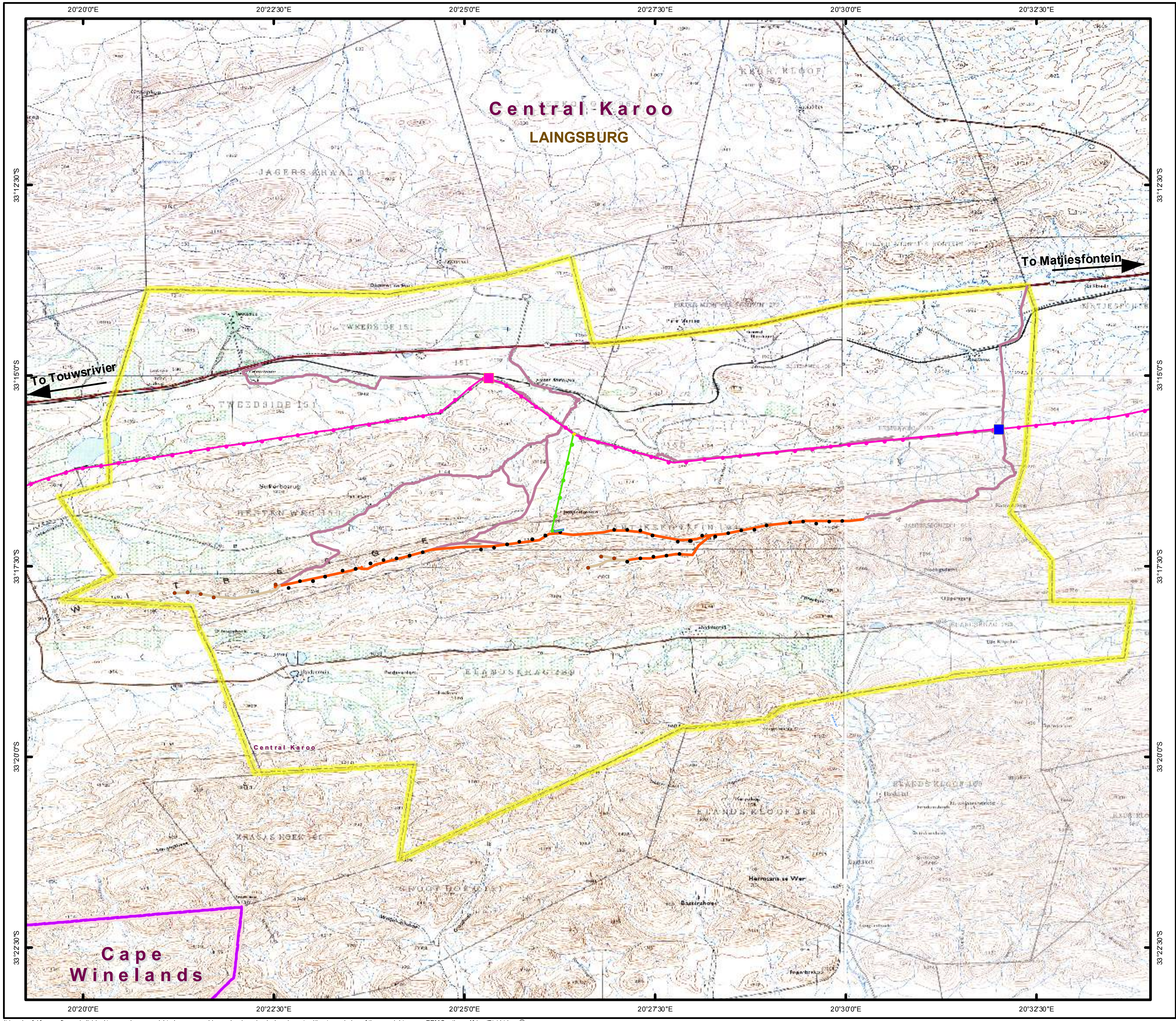
PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				be allowed at the site.			
			24.11	All staff at the site should remain within the compound at night.			
			24.12	No harvesting or collecting of plants, seeds, animals or their parts should be allowed.			
			24.13	Poaching or hunting should be strictly forbidden.			
			24.14	Littering should be strictly forbidden and waste generated by staff or at the compound should be disposed of in an appropriate manner, preferably off-site.			
			24.15	The compound and other temporary lay-down areas should be fenced-off to reduce human-wildlife interactions.	Training material and records of training		
			24.16	All chemical, fuel and oil spills should be cleaned up in the appropriate manner.			
			24.17	It should be mandatory for all contractors to attend an environmental briefing and training session with respect to the guidelines outlined in the EIR and this EMP.			
25.	Visual Impacts	Minimise visual impacts	25.1	Measures to control wastes and litter should be included in the contract specification documents and contractor must agree to these.	ECO report	Contractor Botanist	Throughout construction
			25.2	Rehabilitate/ re-vegetate areas damaged by construction activities.			
			25.3	Borrow pits for the construction (which have not been identified), would be subject to permits from the relevant authorities. Borrow pits on the site are to be rehabilitated and re-vegetated according to the botanist's recommendations.			

POST CONSTRUCTION PHASE					
Activity	Objective	Actions to be undertaken to Mitigate Environmental Impact	Parameters for	Responsibility	Frequency /

#	Description of Activity		#	Commitment / Actions Required / Key Controls	Monitoring		Timing
1.	Temporary site closure	General environmental protection	1.1	During temporary site closure ensure: <u>Fuels and flammables</u>: • Fuel is stored in low volumes • No leak, outlet secure / locked and adequate ventilation present • Bund is empty • Fire extinguishers serviced and accessible • Area secured from accidental damage, e.g. vehicle collision • Emergency contact numbers are displayed. • Safety office checks the stores prior to closure of the site <u>Safety</u> • All trenches secured and fencing and barriers in place • Notice boards applicable and secured • Emergency and management contact details displayed • Security persons briefed and have facility for contact. • Fire hazards identified and precautions taken to limit risks e.g. wood stockpiles, fuels • Inspection schedule and log by security or contracts staff <u>Erosion</u> • Wind and dust mitigation in place • Slopes and stockpiles at stable angle • Re-vegetated areas watering schedule in place <u>Water contamination and pollution</u> • Cement and material stores secured • Refuse bins and toilets emptied and secured • Bunds clean and treated • Drip trays empty and secure • All structures secured against wind damage	Temporary site closure complies with the specified provisions.	Contractor	During any temporary site closures
2.	Permanent Construction site closure	General environmental protection	2.1	All equipment, storage containers, temporary fencing, temporary services, fixtures and solid waste shall be removed from site at the end of construction. Specific	ECO Report	Contractor	Following permanent site closure

PRE- CONSTRUCTION PLANNING PHASE							
Aspect		Objective	Actions to be undertaken to Mitigate Environmental Impact		Parameters for Monitoring	Responsibility	Frequency / Timing
#	Description of Aspect		#	Commitment / Actions Required / Key Controls			
				measures include: • Clear and completely remove from site all equipment, storage containers, temporary fencing, temporary services, fixtures and any other temporary works. • Ensure that all access roads utilised during construction are returned to a usable state and/or a state no worse than prior to construction. • Clear the site of all inert waste and rubble, including surplus rock, foundations and batching plant aggregates (if applicable). • Remove from site all domestic waste and dispose of in the approved manner at a registered waste disposal site.			

APPENDIX K(A):
LAYOUT AND SENSITIVITY MAPS



Legend

- District Municipalities
- Local Municipalities
- Witberg Land Parcels
- Existing Tranmission Line
- Main Road
- Secondary Road
- Other Road
- Track
- Railway
- River
- Contour
- Waterbodies
- Cultivated Land
- Open Areas
- Existing Bantams Traction Linking Station
- Existing Pietermeintjies Traction Substation
- 33/132kV Substation
- Linking Station
- Existing Dual 132Kv Traction Line
- New 132kV line
- Wind Turbines
- Spare Wind Turbines
- Internal Road
- Internal Access Road
- Spare Internal Road

SCALE:

0 1 2 3 4 5

Kilometres

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TITLE:

Figure 5: Site Layout Alternative 3 - Project Infrastructure

CLIENT:

G7 renewable ENERGIES

DATE: April 2011	CHECKED: IE	PROJECT: 0117424
DRAWN: AB	APPROVED: SHC	Scale: 1: 125 000

DRAWING: Witberg_Alt3_Topo_Rev2.mxd

REV: 2

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Woodlands Drive,
Woodmead, 2148
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Fax: +27 (0)11 804 2289

Projection: Geographic, Datum: Wgs 84
Source: NGI, Demarcation Board
Map No: 3320AB,AD & 3320BA&BC
Inset: ESRI Data and Maps

SIZE: A4

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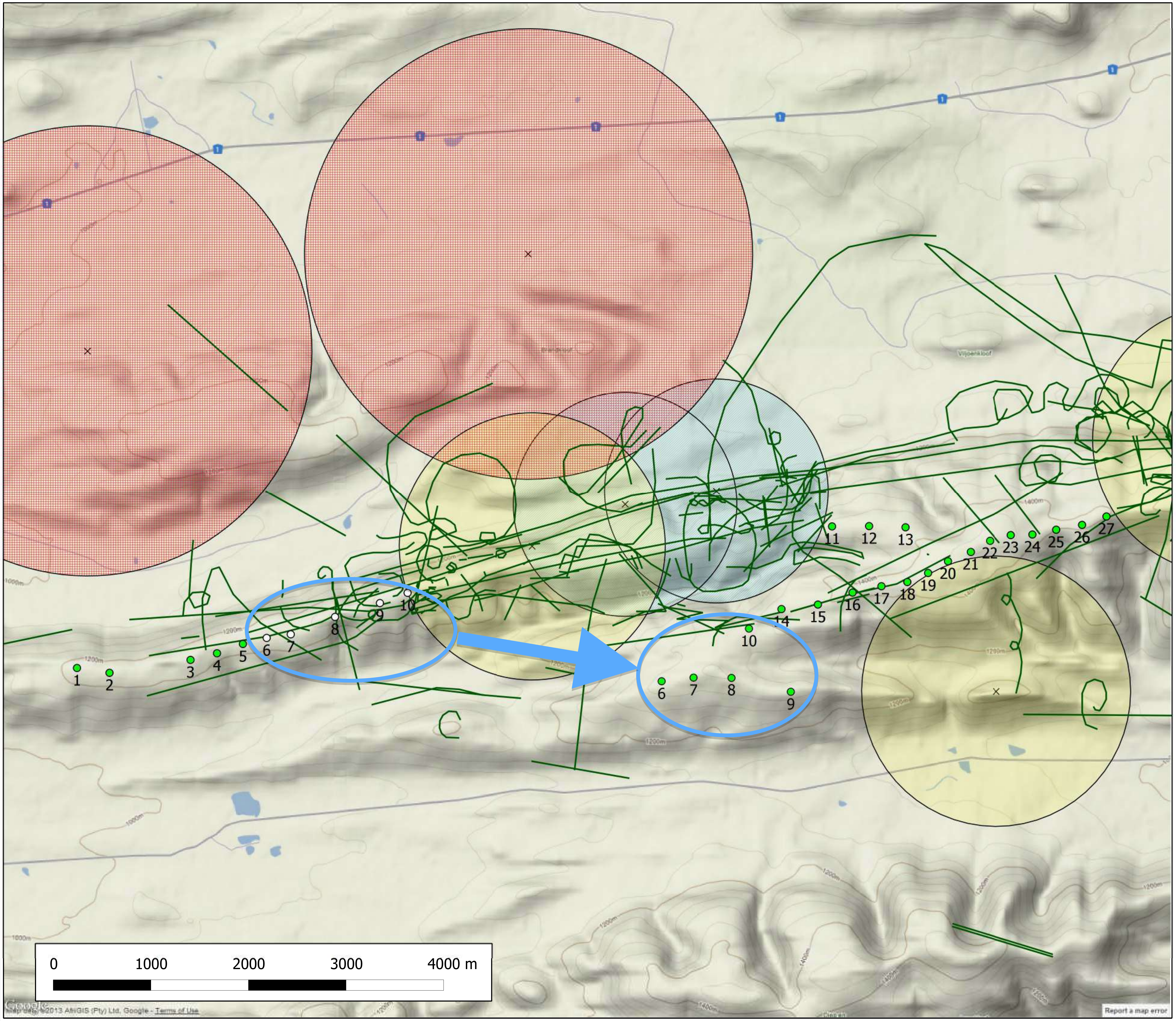


Project Company:	Project:
WITBERG Wind Power	Witberg Wind Power
	Document Name:

Witberg Final Layout Revision and Eagle Flight Paths

Projection: UTM 34S	A3	N

Legend

Pre-CRM - 27 WTG Layout

CRM Adjustments - 27 WTG Layout

Verraux's Eagle 1.5km buffer

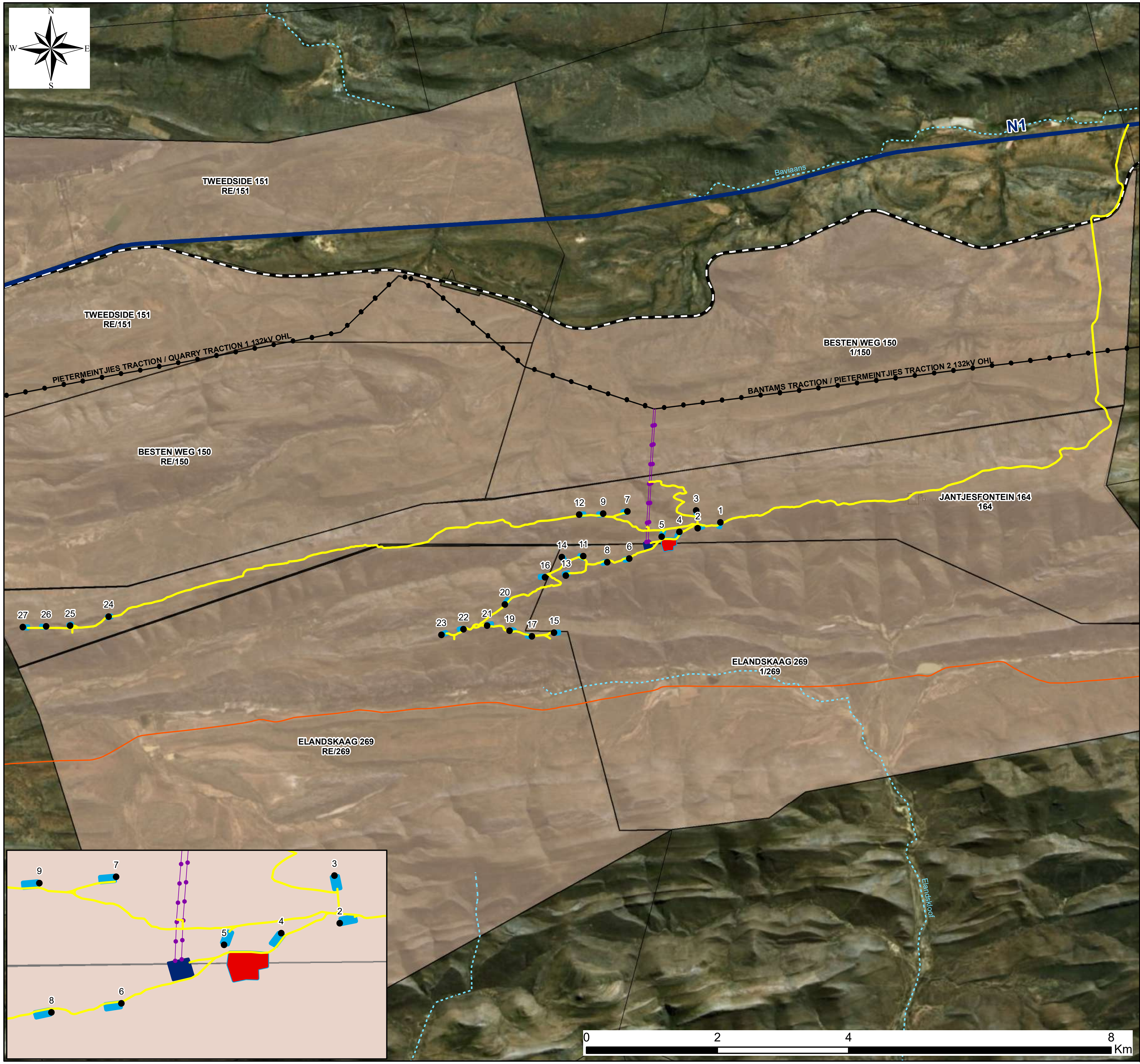
Martial Eagle 2.5km Buffer

Booted Eagle 1.2km Buffer

Observed Eagle Flight Paths

Witberg Wind Farm, Western Cape Province

Layout Map



Legend

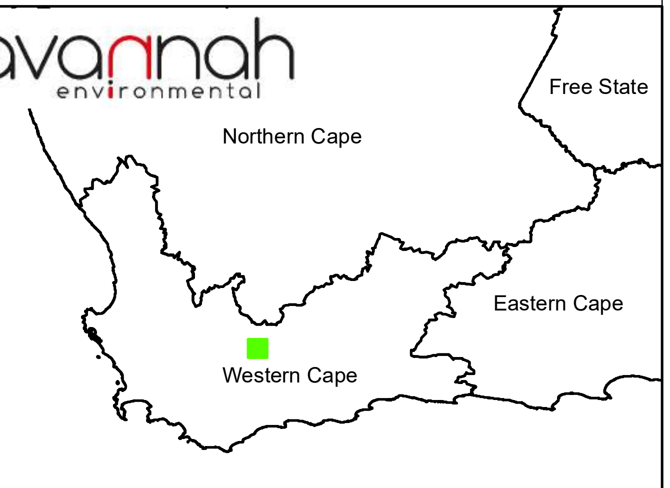
- Existing Power Line
- Main Road
- Railway Line
- Non-perennial River
- Project Site
- Farm Portions

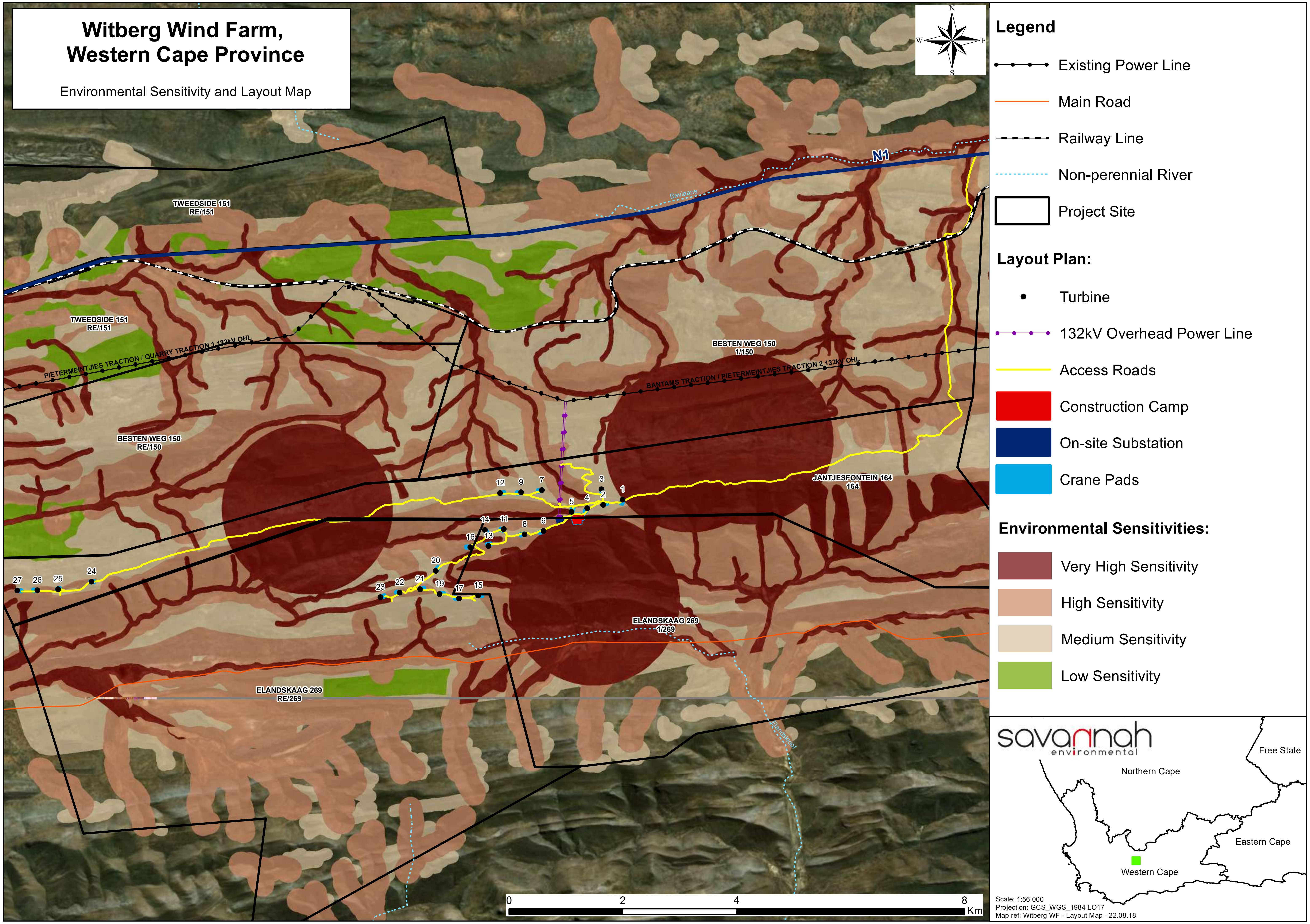
Layout Plan:

- Turbine
- 132kV Overhead Power Line
- Access Roads
- Construction Camp
- On-site Substation
- Crane Pads

Scale: 1:56 000
Projection: GCS_WGS_1984 LO17
Map ref: Witberg WF - Layout Map - 22.08.18

savannah environmental





Witberg Wind Farm, Western Cape Province
Environmental Sensitivity and Layout Map
Legend
Existing Power Line
Main Road
Railway Line
Non-perennial River
Project Site
Layout Plan:
Turbine
132kV Overhead Power Line
Access Roads
Construction Camp
On-site Substation
Crane Pads
Environmental Sensitivities:
Very High Sensitivity
High Sensitivity
Medium Sensitivity
Low Sensitivity
N1
Baviaans
TWEEDSIDE 151 RE/151
TWEEDSIDE 151 RE/151
PIETERMEINTJIES TRACTION / QUARRY TRACTION 1 132kV OHL
BESTEN WEG 150 RE/150
BESTEN WEG 150 1/150
BANTAMS TRACTION / PIETERMEINTJIES TRACTION 2 132kV OHL
JANTJESFONTEIN 164 164
ELANDSKAAG 269 1/269
ELANDSKAAG 269 RE/269
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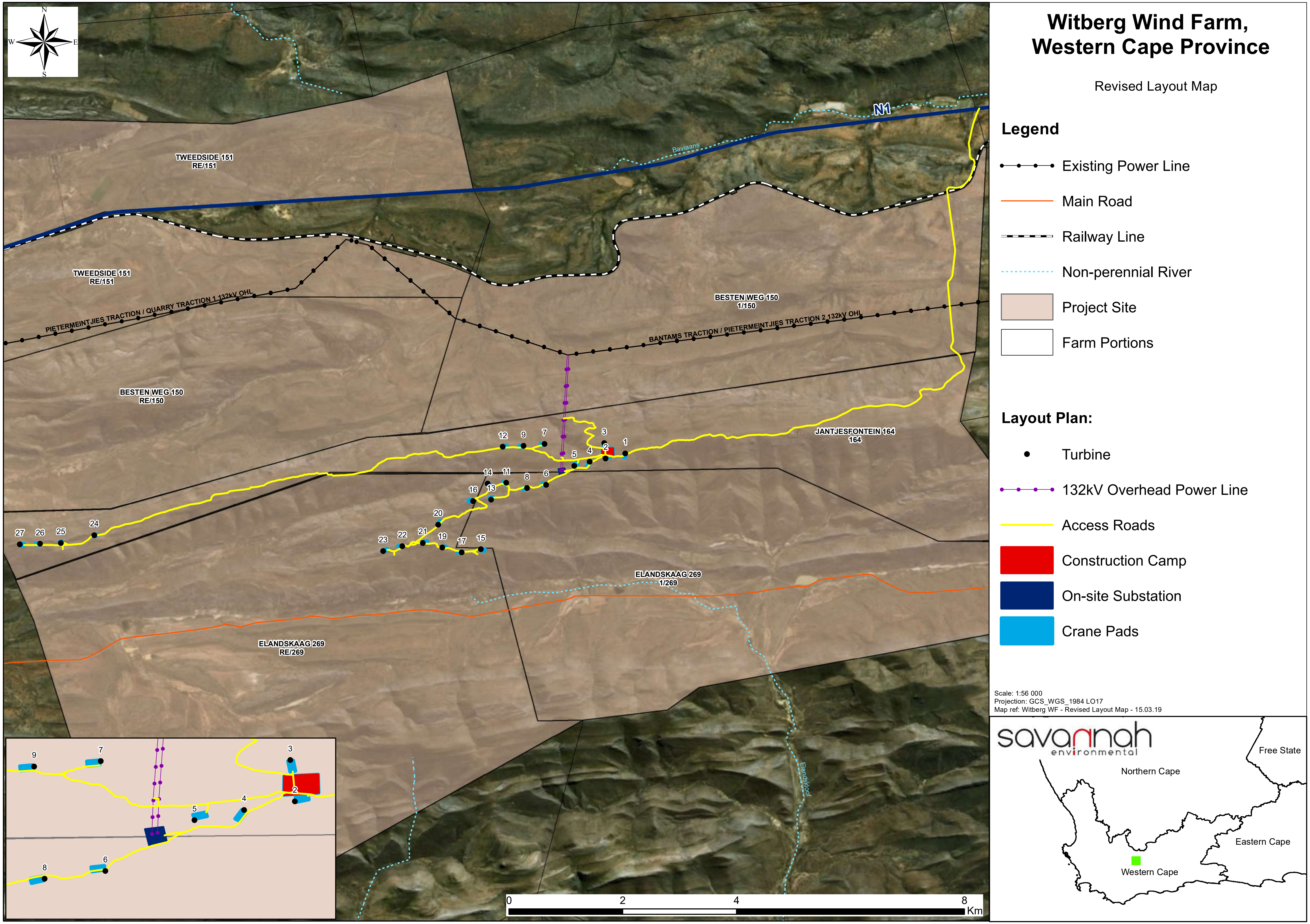
Km
savannah environmental
Free State
Northern Cape
Eastern Cape
Western Cape
Scale: 1:56 000
Projection: GCS_WGS_1984 LO17
Map ref: Witberg WF - Layout Map - 22.08.18


Witberg Wind Farm, Western Cape Province
Revised Layout Map
Legend
Existing Power Line
Main Road
Railway Line
Non-perennial River
Project Site
Farm Portions
Layout Plan:
Turbine
132kV Overhead Power Line
Access Roads
Construction Camp
On-site Substation
Crane Pads
Scale: 1:56 000
Projection: GCS_WGS_1984 LO17
Map ref: Witberg WF - Revised Layout Map - 15.03.19
savannah environmental
Free State
Northern Cape
Eastern Cape
Western Cape
N1
Baviaans
TWEEDSIDE 151 RE/151
TWEEDSIDE 151 RE/151
BESTEN WEG 150 1/150
BESTEN WEG 150 RE/150
PIETERMEINTJIES TRACTION / QUARRY TRACTION 1 132kV OHL
BANTAMS TRACTION / PIETERMEINTJIES TRACTION 2 132kV OHL
JANTJESFONTEIN 164 164
ELANDSKAAG 269 1/269
ELANDSKAAG 269 RE/269
Elandskloof
0 2 4 8 Km
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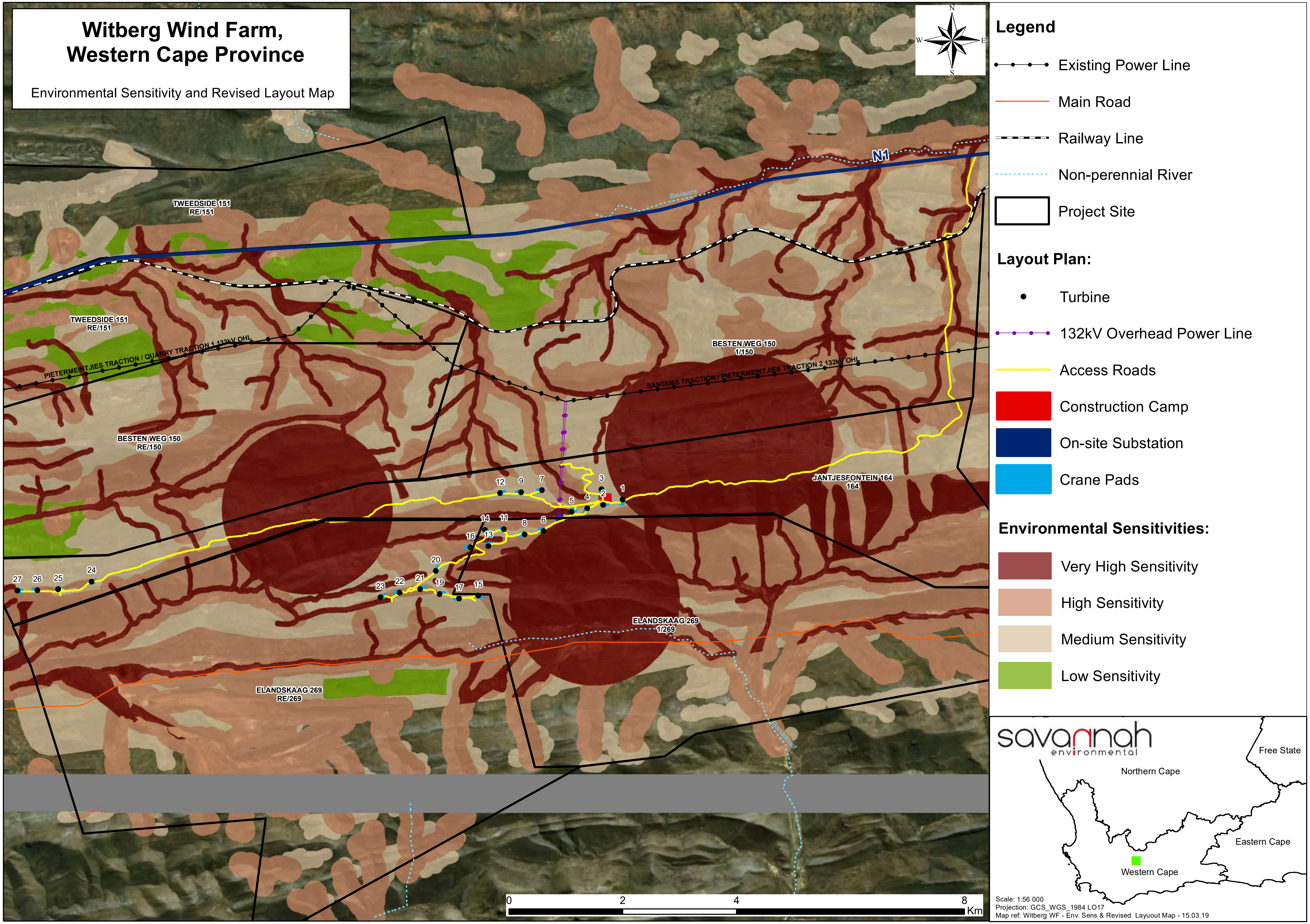
Witberg Wind Farm,
Western Cape Province
Environmental Sensitivity and Revised Layout Map
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E
Legend
Existing Power Line
Main Road
Railway Line
Non-perennial River
Project Site
Layout Plan:
Turbine
132kV Overhead Power Line
Access Roads
Construction Camp
On-site Substation
Crane Pads
Environmental Sensitivities:
Very High Sensitivity
High Sensitivity
Medium Sensitivity
Low Sensitivity
N1
Baviaans
TWEEDSIDE 151 RE/151
TWEEDSIDE 151 RE/151
PIETERMEINTJIES TRACTION / QUARRY TRACTION 1 132kV OHL
BESTEN WEG 150 RE/150
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BANTAMS TRACTION / PIETERMEINTJIES TRACTION 2 132kV OHL
JANTJESFONTEIN 164 164
ELANDSKAAG 269 1/269
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1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 19 20 21 22 23 24 25 26 27
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savannah environmental
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Northern Cape
Eastern Cape
Western Cape
Scale: 1:56 000
Projection: GCS_WGS_1984 LO17
Map ref: Witberg WF - Env. Sens & Revised Layout Map - 15.03.19

APPENDIX K(B):
ALIEN PLANT MANAGEMENT PLAN

WITBERG WIND ENERGY FACILITY:

ALIEN INVASIVE PLANT MANAGEMENT PLAN

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

3Foxes Biodiversity Solutions

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March 2019

MANAGEMENT PLAN OBJECTIVES

The purpose of the Witberg Wind Energy Facility Alien Plant Management Plan is to provide a framework for the management of alien and invasive plant species during the construction and operation of the Witberg Wind Energy Facility. The broad objectives of the plan include the following:

- Ensure alien plants do not become dominant in parts or the whole site through the control and management of alien and invasive species presence, dispersal & encroachment.
- Initiate and implement a monitoring and eradication programme for alien and invasive species.
- Promote the natural re-establishment and planting of indigenous species in order to retard erosion and alien plant invasion.

PROBLEM BACKGROUND & LEGISLATIVE BACKGROUND

Alien plants require management because they may impact biodiversity as well as the provision of ecosystem services which contribute to human livelihoods and well-being. In recognition of these impacts, South Africa has legislation in place which requires landowners to clear or prevent the spread of certain declared weeds from their properties. Within the context of the wind energy facilities, alien plant invasion can be problematic as they may increase the risk of fire within the facilities, spread into the surrounding natural vegetation or be more costly or difficult to control than the indigenous grassland.

In terms of the legislation, the Conservation of Agricultural Resources Act (CARA, Act 43 of 1983), as amended in 2001, requires that landusers clear *Declared Weeds* from their properties and prevent the spread of *Declared Invader Plants* on their properties. Table 3 of CARA lists all declared weeds and invader plants that must be controlled. Alien plants are divided into 3 categories based on their risk and potential impact as an invader.

- Category 1 - These plants must be removed and controlled by all land users. They may no longer be planted or propagated and all trade in these species is prohibited.

- Category 2 – These plants pose a threat to the environment but nevertheless have commercial value. These species are only allowed to occur in demarcated areas and a landuser must obtain a water use licence as these plants consume large quantities of water.

- Category 3 – These plants have the potential of becoming invasive but are considered to have ornamental value. Existing plants do not have to be removed but no new plantings may occur and the plants may not be sold.

The following guide is a useful starting point for the identification of alien species:

Bromilow, C. 2010. *Problem Plants and Alien Weeds of South Africa*. Briza, Pretoria.

ALIEN SPECIES PRESENCE & ABUNDANCE AT WITBERG

The Witberg project site is not currently significantly invaded by alien species, although some minor weedy species were observed to be present. The only significant woody alien in the area is *Prosopis glandulosa* which is common along the drainage lines of the lowlands of the area but is currently not a significant invader at the site. Alien species are likely to become problematic in areas which are disturbed or which receive runoff from the hardened surfaces of the site, such as roads and turbine hard-standings. Information on alien species including photographs can be found on the following website: http://www.invasives.org.za/invasive-plants.html

ACTIVITIES LIKELY TO IMPACT ALIEN SPECIES ABUNDANCE

Alien species are adept at taking advantage of disturbance and many of their traits are linked to this ability. This usually includes the ability to produce large amounts of seed or being flexible in terms of their size, growth form or reproductive strategy. Alien plant control strategies therefore need to focus on these key attributes while management practices need to ensure that they do not create circumstances under which alien species are encouraged or can thrive. Perhaps the most important aspects in this regard are minimising disturbance and ensuring the retention of indigenous vegetation as far as possible.

It is important to note that it is not possible or practical to prevent alien species from entering the facility site as seed. Many alien species travel well on vehicles and it is inevitable that some alien species will be introduced to the site with construction materials or on construction vehicles. In addition, any activities which result in the loss of plant cover or the disturbance of the soil surface will stimulate the invasion of alien species. This includes clearing for roads, turbines, buildings, substations and any other infrastructure.

Within the context of the site, areas which receive runoff and those areas of disturbed soil which are not rehabilitated are likely to be most vulnerable to alien invasion, in the short term as well as during the operation phase of the development. As runoff can create erosion and disturbance, it is also likely that poor runoff management at the site will promote the invasion of alien species. During construction, there will be a large number of vehicles entering and leaving the site and many of these will have come from elsewhere and may bring seed of the above or other problem species with them in mud, dirt or material carried by the vehicles. Therefore, even if a species is not currently present at the site, it is likely that it may become introduced during construction. As it is easier to control alien species while their abundance is still low, control should begin during construction to ensure that species can be combatted while their abundance is still low.

RECOMMENDED MANAGEMENT PRACTICE & CLEARING METHODS

The following general principles and observations underlie the alien management plan during and following construction:

- Alien species presence will vary from year to year in terms of abundance, density and the identity of species present. This can be ascribed largely to variation in rainfall timing and amount, which will favour a different suite of species each year. Therefore, occasional outbreaks of certain species is not likely to be cause for concern, whereas a persistent high or increasing abundance of a species is indicative of a species where control may be required.
- Management practices will impact indigenous as well as alien species. Disturbance should be kept to minimum.
- Alien management is an iterative process and it may require repeated control efforts to significantly reduce the abundance of a species. This is often due to the presence of large and persistent seed banks. However, repeated control usually results in rapid decline once seed banks become depleted.

GENERAL CLEARING & GUIDING PRINCIPLES

- Alien control programs are long-term management projects and should include a clearing plan which includes follow up actions for rehabilitation of the cleared area.
- The lesser infested areas should be cleared first to prevent the build-up of seed banks.
- Pre-existing dense mature stands ideally should be left for last, as they probably won't increase in density or pose a greater threat than they are currently.
- Collective management and planning with neighbours may be required in the case of large woody invaders as seeds of aliens are easily dispersed across boundaries by wind or water courses.
- All clearing actions should be monitored and documented to keep track of which areas are due for follow-up clearing.

CLEARING METHODS

- Different species require different clearing methods such as manual, chemical or biological methods or a combination of both.
- However care should be taken that the clearing methods used do not encourage further invasion. As such, regardless of the methods used, disturbance to the soil should be kept to a minimum.
- Fire is not a natural phenomenon in the area and fire should not be used for alien control or vegetation management at the site.
- The best-practice clearing method for each species identified should be used. The preferred clearing methods for most alien species can be obtained from the DWAF Working for Water Website. http://www.dwaf.gov.za/wfw/Control/

Use of Herbicides for Alien Control

Although it is usually preferable to use manual clearing methods where possible, such methods may create additional disturbance which stimulates alien invasion and may also be ineffective for many woody species which resprout. Where herbicides are to be used, the impact of the operation on the natural environment should be minimised by observing the following:

- Area contamination must be minimised by careful, accurate application with a minimum amount of herbicide to achieve good control.
- All care must be taken to prevent contamination of any water bodies. This includes due care in storage, application, cleaning equipment and disposal of containers, product and spray mixtures.
- Equipment should be washed where there is no danger of contaminating water sources and washings carefully disposed of in a suitable site.
- To avoid damage to indigenous or other desirable vegetation, products should be selected that will have the least effect on non-target vegetation.
- Coarse droplet nozzles should be fitted to avoid drift onto neighbouring vegetation.
- The appropriate health and safety procedures should also be followed regarding the storage, handling and disposal of herbicides.

For all herbicide applications, the following guidelines should be followed:

Working for Water: Policy on the Use of Herbicides for the Control of Alien Vegetation.

ALIEN PLANT MANAGEMENT & MONITORING PLAN

In order to implement the alien plant management plan, a monitoring and control schedule is required to evaluate the presence and on-going control of alien plants within the facility. This provides a guideline on the frequency with which alien plants should be monitored and what parameters are likely to be important

Construction Phase Activities

The following management actions are aimed at reducing soil disturbance during the construction phase of the development, as well as reducing the likelihood that alien species will be brought onto site or otherwise encouraged.

Action	Frequency
The ECO is to provide permission prior to any vegetation being cleared for development.	Daily
Clearing of vegetation should be undertaken as the work front progresses – mass clearing should not occur unless the cleared areas are to be surfaced or prepared immediately afterwards.	Weekly

Where cleared areas will be exposed for some time, these areas should be protected with packed brush, or appropriately battered with fascine work. Alternatively, jute (Soil Saver) may be pegged over the soil to stabilise it.	Weekly
Cleared areas that have become invaded can be sprayed with appropriate herbicides provided that these are such that break down on contact with the soil. Residual herbicides should not be used.	Weekly
Although organic matter is frequently used to encourage regrowth of vegetation on cleared areas, no foreign material for this purpose should be brought onto site. Brush from cleared areas should be used as much as possible. The use of manure or other soil amendments is likely to encourage invasion.	Weekly
Clearing of vegetation is not allowed within 32m of any wetland, 80m of any wooded area, within 1:100 year floodlines, in conservation servitude areas or on slopes steeper than 1:3, unless permission is granted by the ECO for specifically allowed construction activities in these areas.	Weekly
Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment.) Stockpiles should be checked regularly and any weeds emerging from material stockpiles should be removed.	Weekly
Alien vegetation regrowth on areas disturbed by construction must be controlled throughout the entire site during the construction period.	Monthly
The alien plant removal and control method guidelines should adhere to best-practice for the species involved. Such information can be obtained from the DWAF Working for Water website.	Monthly
Clearing activities must be contained within the affected zones and may not spill over into demarcated No Go areas.	Daily
Pesticides may not be used. Herbicides may be used to control listed alien weeds and invaders only.	Monthly
Wetlands and other sensitive areas should remain demarcated with appropriate fencing or hazard tape. These areas are no-go areas (this must be explained to all workers) that must be excluded from all development activities.	Daily

MONITORING – CONSTRUCTION PHASE

The following monitoring actions should be implemented during the construction phase of the development.

Monitoring Action	Indicator	Timeframe
Document alien species present at the site	List of alien species	Preconstruction
Document alien plant distribution	Alien plant distribution map within priority areas	3 Monthly

Document & record alien control measures implemented	Record of clearing activities	3 Monthly
Review & evaluation of control success rate	Decline in documented alien abundance over time	Biannually

Operational Phase Activities

The following management actions are aimed at reducing the abundance of alien species within the site and maintaining non-invaded areas clear of aliens.

Action	Frequency
Surveys for alien species should be conducted regularly. Every 6 months for the first two years after construction and annually thereafter. All aliens identified should be cleared.	Every 6 months for 2 years and annually thereafter
Where areas of natural vegetation have been disturbed by construction activities, revegetation with indigenous, locally occurring species should take place where the natural vegetation is slow to recover or where repeated invasion has taken place following disturbance.	Biannually, but revegetation should take place at the start of the rainy season
Areas of natural vegetation that need to be maintained or managed to reduce plant height or biomass, should be controlled using methods that leave the soil protected, such as using a weed-eater to mow above the soil level.	When necessary
No alien species should be cultivated on-site. If vegetation is required for aesthetic purposes, then non-invasive, water-wise locally-occurring species should be used.	When necessary

Monitoring – Operational Phase

The following monitoring and evaluation actions should take place during the operational phase of the development.

Monitoring Action	Indictor	Timeframe
Document alien species distribution and abundance over time at the site	Alien plant distribution map	Biannually
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate. A decline in alien distribution and cover over time at the site	Biannually
Document rehabilitation measures implemented and	Decline in vulnerable bare areas over time	Biannually

success achieved in problem areas		

CONCLUSIONS AND RECOMMENDATIONS

- The site is relatively undisturbed with the result that alien species abundance at the site is currently very low. However, disturbance within the site would be likely to encourage the invasion of some alien species. As a result, alien control should begin during the construction phase to ensure that the density and abundance of alien species remains manageable into the operational phase.
- In the short-term, soil disturbance is likely to be the dominant driver of alien invasion at the site. While, in the long-term the distribution of runoff is likely to be a key driver as those areas which receive water will be wetter and likely to contain a higher alien abundance.
- As disturbance is the major initial driver of alien species invasion, keeping the disturbance footprint to a minimum is a key element in reducing alien abundance. Wherever possible, the indigenous vegetation should be left intact as this will significantly reduce the likelihood of alien invasion as well as other degradation problems such as erosion.

APPENDIX K(C):
RE-VEGETATION AND HABITATA REHABILITATION PLAN

WITBERG WIND ENERGY FACILITY:

REVEGETATION & REHABILITATION PLAN

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

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March 2019

BACKGROUND & PURPOSE

The purpose of the Witberg Wind Energy Facility Revegetation and Rehabilitation plan is to ensure that areas cleared or impacted during construction activities of the proposed Facility are rehabilitated with a plant cover that reduces the risk of erosion from these areas as well as restores ecosystem function. The purpose the rehabilitation at the site can be summarized as follows:

- Achieve long-term stabilisation of all disturbed areas to minimise erosion potential;
- Re-vegetate all disturbed areas with suitable local plant species;
- Minimise visual impact of disturbed areas; and
- Ensure that disturbed areas are safe for future uses.

It is also important to recognize that the rehabilitation plan should also be closely aligned with the other management plans for the site as revegetation, site management and erosion are inextricably linked.

REHABILITATION MANAGEMENT PRINCIPLES

Topsoil management

Effective topsoil management is a critical element of rehabilitation, particularly in arid areas where soil properties are a fundamental determinant of vegetation composition and abundance. Where any excavation or topsoil clearing is required, the topsoil should be used immediately where possible or stockpiled and later used to cover cleared and disturbed areas once construction activity has ceased.

- Topsoil is the top-most layer (0-25cm) of the soil in undisturbed areas. This soil layer is important as it contains nutrients, organic matter, seeds, micro-organisms fungi and soil fauna. All these elements are necessary for soil processes such as nutrient cycling and the growth of new plants. The biologically active upper layer of the soil is fundamental in the maintenance of the entire ecosystem. There are however, large parts of the site on weathered shale gravel or on exposed calcrete where there is basically no topsoil. In these areas, the upper layers should not be removed and stockpiled as there is no soil structure and recovery in these areas occur more spontaneously as a result.
- Topsoil should be retained on site in order to be used for site rehabilitation. The correct handling of the topsoil is a key element to rehabilitation success. Firstly it is important that the correct depth of topsoil is excavated. If the excavation is too deep, the topsoil will be mixed with sterile deeper soil, leading to reduction in nutrient levels and a decline in plant performance on the soil. It is recommended that no more than the top 10cm of topsoil are stored and used for rehabilitation.
- Wherever possible, stripped topsoil should be placed directly onto an area being rehabilitated. This avoids stockpiling and double handling of the soil. Topsoil placed directly onto rehabilitation

areas contains viable seed, nutrients and microbes that allow it to revegetate more rapidly than topsoil that has been in stockpile for long periods.

- If direct transfer is not possible, the topsoil should be stored separately from other soil heaps until construction in an area is complete. The soil should not be stored for a long time and should be used as soon as possible. The longer the topsoil is stored, the more seeds, micro-organisms and soil biota are killed.
- Ideally stored topsoil should be used within a month and should not be stored for longer than three months. In addition, topsoil stores should not be too deep, a maximum depth of 1m is recommended to avoid compaction and the development of anaerobic conditions within the soil.
- If topsoil is stored on a slope then sediment fencing should be used downslope of the stockpile in order to intercept any sediment and runoff should be directed away from the stockpiles upslope.

MULCHING

Mulching is the covering of the soil with a layer of organic matter of leaves, twigs bark or wood chips, usually chopped quite finely. The main purpose of mulching is to protect and cover the soil surface as well as serve as a source of seed for revegetation purposes.

- Plant cover at the site is however low and averages around 25-30% projected cover, with the result that significant amounts of plant material to use for mulching is not likely to be generated or available at the site.
- During site clearing the standing woody vegetation should not be mixed with the soil, but where significant biomass is present it can be cleared separately. The cleared vegetation should be stockpiled and used whole or shredded by hand or machine to protect the soil in disturbed areas and promote the return of indigenous species. Where there is a low shrub or grass layer, this material can be cleared and mixed as part of the topsoil as this will aid revegetation and recovery when it is reapplied.
- Material for mulch should be harvested from areas that are to be denuded of vegetation during construction activities, provided that they are free of seed-bearing alien invasive plants;
- No harvesting of vegetation may be done outside the area to be disturbed by construction activities;
- Brush-cut mulch should be stored for as short a period as possible, and seed released from stockpiles can also be collected for use in the rehabilitation process.
- There are few areas present at the site which would justify the collection of material for mulching as the standing biomass is too low and areas with a higher biomass are generally restricted to drainage lines which would be largely avoided by the development footprint. However, where possible, this approach can be opportunistically used. Specific care should however be exercised to ensure that any harvested material does not contain alien plants that would rapidly establish on the disturbed areas.

SEEDING

In some areas the natural regeneration of the vegetation may be poor and the application of seed to enhance vegetation recovery may be required. Seed should be collected from plants present at the site and should be used immediately or stored appropriately and used at the start of the following wet season. Seed can be broadcast onto the soil, but should preferably be applied in conjunction with measures to improve seedling survival such as scarification of the soil surface or simultaneous application of mulch.

- Indigenous seeds may be harvested for purposes of re-vegetation in areas that are free of alien or invasive vegetation, either at the site prior to clearance or from suitable neighbouring sites;
- Seed may be harvested by hand and if necessary dried or treated appropriately;
- Seed gathered by vacuum harvester, or other approved mass collection method, from suitable shrubs or from the plant litter surrounding the shrubs must be kept apart from individually harvested seed;
- No seed of alien or foreign species should be used or bought onto the site.

TRANSPLANTS

Where succulent plants are available or other species which may survive translocation are present, individual plants can be dug out from areas about to be cleared and planted into areas which require revegetation. This can be an effective means of establishing indigenous species quickly and within the context of the current site, this is likely to be an effective means of rehabilitation on some areas because establishing perennial species from seed in this arid environment is likely to be challenging. The primary purpose of using transplants is not to restore plant cover to its' former levels, but rather to provide nodes of biological activity and a source of propagules that can spread and recover disturbed areas on their own. As such transplants should be planted in clumps rather than as isolated individuals.

- Plants for transplant should preferably be removed from areas that are going to be cleared.
- Succulent shrubs and geophytes are the most suitable candidates for transplant. Most woody species are not likely to survive transplant once the roots have been disturbed.
- Transplants should be placed within a similar environment from where they came in terms of aspect, slope and soil depth.
- Transplants must remain within the site and may not be transported off the site.

USE OF SOIL SAVERS

In areas where seed and organic matter retention is low, it is recommended that soil savers are used to stabilise the soil surface. The site is windy and wind erosion is likely to be a potentially significant issue at the site following construction and measures to protect the soil surface including soil savers may to be necessary. Soil savers are man-made materials, usually constructed of organic material such as hemp or jute and are usually applied in areas where traditional rehabilitation techniques are not likely to succeed.

- In areas where soil saver is used, it should be pegged down to ensure that is captures soil and organic matter flowing over the surface.
- Soil saver may be seeded directly once applied as the holes in the material catch seeds and provide suitable microsites for germination. Alternatively, fresh mulch containing seed can be applied to the soil saver.

GENERAL RECOMMENDATIONS

- Progressive rehabilitation is an important element of the rehabilitation strategy and should be implemented where feasible.
- Once revegetated, areas should be protected to prevent trampling and erosion.
- No construction equipment, vehicles or unauthorised personnel should be allowed onto areas that have been vegetated.
- Where rehabilitation sites are located within actively grazed areas, they should be fenced.
- Fencing should be removed once a sound vegetative cover has been achieved.
- Any runnels, erosion channels or wash-aways developing after revegetation should be backfilled and consolidated and the areas restored to a proper stable condition.

MONITORING REQUIREMENTS

As rehabilitation success, particularly in arid areas is unpredictable, monitoring and follow-up actions are important to achieve the desired cover and soil protection.

- Re-vegetated areas should be monitored every 6 months for the first 18 months following construction.
- Re-vegetated areas showing inadequate surface coverage (less than 10% within 12 months after re-vegetation) should be prepared and re-vegetated;
- Any areas showing erosion, should be re-contoured and seeded with indigenous grasses or other locally occurring species which grow quickly.

CONCLUSIONS AND RECOMMENDATIONS

- The most cost-effective way to reduce the cost and effort for rehabilitation is to reduce and minimize the disturbance footprint. Particular attention should be paid to the location of temporary-use areas such as any lay-down areas which should be located in disturbed areas.
- The site is windy and large amounts of dust may be generated from cleared areas. As a result, specific measures to reduce dust and protect the soil are likely to be required. The simplest solution to this problem is to minimise the amount of vegetation clearing at the site.
- No seed or plants from outside of the area should be brought onto the site for rehabilitation purposes. If established plants must be brought onto the site for rehabilitation, then these should be grown from seed or vegetative material collected on-site. This is because, even within a single species, there are local variants adapted to the local conditions and plants from elsewhere can contaminate the local gene pool.

APPENDIX K(D):
PLANT RESCUE PLAN AND PROTECTION PLAN

WITBERG WIND ENERGY FACILITY:

PLANT RESCUE & PROTECTION PLAN

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

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March 2019

MANAGEMENT PLAN OBJECTIVES

The purpose of the Witberg plant rescue and protection plan is to implement avoidance and mitigation measures to reduce the impact of the development of the Witberg Wind Energy Facility on listed and protected plant species and their habitats during construction and operation.

IDENTIFICATION OF SPECIES OF CONSERVATION CONCERN

The ToPS (Threatened and Protected Species) regulations provide for the regulation of activities which may directly or indirectly impact threatened and protected species. Such species are identified under NEMBA as well as by the National Red Data List of Plants. DAFF also publishes lists of nationally protected tree species on a regular basis. At a provincial level, the Western Cape Nature Conservation Laws Amendment Act (2000) which is administered by CapeNature also provides lists of species which are protected within the Western Cape Province. Species listed under the National Red Data List of Plants as well as those protected under the provincial legislation and by DAFF must be specified on permit applications required for site clearing.

MITIGATION & AVOIDANCE OPTIONS

Where listed plant species fall within the development footprint and avoidance is not possible, then it may be possible to translocate the affected individuals outside of the development footprint. However, not all species are suitable for translocation as only certain types of plants are able to survive the disturbance. Suitable candidates for translocation include most geophytes and succulents. Although there are exceptions, the majority of woody species do not survive translocation well and it is generally not recommended to try and attempt to translocate such species.

While the density of species of conservation concern at the Witberg is low within most of the site, there are a number of localised habitats present where the abundance of such species is higher. Where possible avoidance of such habitats is the most effective way of ensuring a low impact on listed and protected species. This would occur at the preconstruction stage following a walk-through of the facility and micrositing of the turbines and final access road routes.

RESCUE AND PROTECTION PLAN

Preconstruction

- Identification of all listed species which may occur within the site, based on the SANBI SIBIS database as well as the specialist EIA studies for the site and any other relevant literature.

Before construction commences at the site, the following actions should be taken:

- A walk-through of the final development footprint by a suitably qualified botanist/ecologist to locate and identify all listed and protected species which fall within the development footprint. This should happen during the flowering season at the site which depending on rainfall is likely to be during spring to early summer (August-September).
- A walk-through report following the walk-through which identifies areas where minor deviations to roads and other infrastructure can be made to avoid sensitive areas and important populations of listed species. The report should also contain a full list of localities where listed species occur within the development footprint and the number of affected individuals in each instance, so that this information can be used to comply with the permit conditions required by the authorization as well as provincial requirements.
- A permit to clear the site and relocated species of concern is required from CapeNature before construction commences. There are no listed tree species present at the site and a permit from DAFF to clear protected trees is not required.
- Once a permit has been issues, there should be a search and rescue operation of all listed species within the development footprint that cannot be avoided. Affected individuals should be translocated to a similar habitat outside of the development footprint and marked for monitoring purposes. Those species suitable for search as rescue should be identified in the walk-through report. It is important to note that a permit is required to translocate or destroy any listed and protected species even if they do not leave the property.

Construction

- Vegetation clearing should take place in a phased manner, so that large cleared areas are not left standing with no activity for long periods of time and pose a wind and water erosion risk. This will require coordination between the contractor and ECO, to ensure that the ECO is able to monitor activities appropriately.
- All cleared material should be handled according to the Revegetation and Rehabilitation Plan and used to encourage the recovery of disturbed areas.
- ECO to monitor vegetation clearing at the site. Any deviations from the plans that may be required should first be checked for listed species by the ECO and any listed species present which are able to survive translocation should be translocated to a safe site.
- All areas to be cleared should be demarcated with construction tape, survey markers or similar. All construction vehicles should work only within the designated area.
- Plants suitable for translocation or for use in rehabilitation of already cleared areas should be identified and relocated before general clearing takes place.
- Any listed species observed within the development footprint that were missed during the preconstruction plant sweeps should be translocated to a safe site before clearing commences.

- Many listed species are also sought after for traditional medicine or by collectors and so the ECO should ensure that all staff attend environmental induction training in which the legal and conservation aspects of harvesting plants from the wild are discussed.
- The ECO should monitor construction activities in sensitive habitats such as gravel patches or near rivers and wetlands carefully to ensure that impacts to these areas are minimized.

Operation

- Access to the site should be strictly controlled and all personnel entering or leaving the site should be required to sign and out with the security officers.
- The collecting of plants of their parts should be strictly forbidden and signs stating so should be placed at the entrance gates to the site.

MONITORING & REPORTING REQUIREMENTS

The following reporting and monitoring requirements are recommended as part of the plant rescue and protection plan:

- Preconstruction walk-through report detailing the location and distribution of all listed and protected species. This should include a walk-through of all infrastructure including all new access roads, turbine locations, turbine service areas, underground cables, power line routes, buildings and substations. The report should include recommendations of route adjustments where necessary, as well as provide a full accounting of how many individuals of each listed species will be impacted by the development.
- Permit application to CapeNature. This requires the walk-through report as well as the identification and quantification of all listed and protected species within the development footprint. The permit is required before and search and rescue can take place. Where large numbers of listed species are affected a site inspection and additional requirements may be imposed by CapeNature as part of the permit conditions. All documentation associated with this process needs to be retained and the final clearing permit should be kept at the site.
- Active daily monitoring of clearing during construction by the ECO to ensure that listed species and sensitive habitats are avoided. All incidents should be recorded along with the remedial measures implemented.
- Post construction monitoring of plants translocated during search and rescue to evaluate the success of the intervention. Monitoring for a year post-transplant should be sufficient to gauge success.

APPENDIX K(E):
OPEN SPACE MANAGEMENT PLAN

WITBERG WIND ENERGY FACILITY:

OPEN SPACE MANAGEMENT PLAN

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

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March 2019

PURPOSE

The purpose of the Witberg Wind Energy Facility, Open Space Management Plan (OSMP) is to provide a framework for the integrated management of the natural spaces within the Witberg Wind Energy Facility. The footprint of the facility will occupy a small proportion of the site, but impacts resulting from the construction and operational activities of the facility may spread well beyond the required footprint and impact biodiversity within the site more generally. The goal of the OSMP is to reduce the ecological footprint of the Witberg Wind Energy Facility through ensuring that the facility operates in a biodiversity-compatible manner and does not have a long-term negative impact on the local environment.

PROBLEM OUTLINE

The Witberg Wind Energy facility would consist of 25 wind turbines with associated infrastructure and access roads, an on-site substation and overhead line to the Eskom grid. The total footprint of the facility is estimated at ~50ha. However, alien plant invasion, soil erosion, motor vehicle impacts, noise and disturbance generated by the operational activities and human disturbance are potential impacts that may occur on an on-going basis at the site and extend well beyond the actual footprint. The site is home to a variety of fauna, including listed species and potential negative impacts on these animals should be minimised as much as possible. Furthermore, the site contains several listed plant species and specialised habitats and there is a danger that these may be impacted on an on-going basis.

RELATION TO OTHER SUBPLANS

During construction, there are a variety of subplans developed as part of the EMPr for the development that are aimed at ensuring that construction occurs in a responsible and biodiversity-compatible manner. This includes the Plant Rescue and Protection Plan, Revegetation and Rehabilitation Plan and Alien Management Plan. The purpose of the Open Space Management Plan is to ensure that all the different plans are aligned, and that additional measures are implemented during the operation of the facility to ensure that negative environmental impacts of the development are minimised.

OPEN SPACE MANAGEMENT SUBPLAN

The following elements are considered part of the Open Space Management Subplan

Access Control:

- Access to the facility should be strictly controlled.
- All visitors and contractors should be required to sign-in.
- Signage at the entrance should indicate that disturbance to fauna and flora is strictly prohibited.
- The fencing around the facility should consist of a single fence with electrified strands only on the inside of the fence and not the outside.

Prohibited Activities:

The following activities should not be permitted within the facility by anyone except as part of the other management programmes of EMP for the development.

- No fires within the site.
- No hunting, collecting or disturbance of fauna and flora, except where required for the safe operation of the facility and only by the Environmental Officer on duty and with the appropriate permits and landowner permission.
- No dogs should be allowed on site.
- No driving off of demarcated roads.
- No interfering with livestock.

Fire Risk Management:

The site is within an area where fires are a natural occurrence and measures should be taken to ensure that fire risk at the site is minimised.

The National Veld and Forest Fires Act places responsibility on the landowner to ensure that the appropriate equipment as well as trained personnel are available to combat fires. Therefore, the management of the facility should ensure that they have suitable equipment as well as trained personnel available to assist in the event of fire.

Alien Plant Control

- Alien invasive plants should be controlled according to the Alien Invasive Management Plan.
- No non-locally occurring or alien plants should be established or brought onto the site.

Erosion Management

- The facility should be inspected every 6 months for erosion problems or more frequently in the event of exceptional rainfall events. All erosion problems should be rectified according to the Rehabilitation and Erosion Management Subplan.

Faunal Management

The site will remain a largely natural environment with a full complement of resident natural fauna, including a variety of mammals, reptiles and frogs that may be impacted by day to day activities at the site. The management of the facility should be aimed at trying to minimise interactions between wildlife and the facility in terms of its staff, infrastructure and activities.

- Bird monitoring and mitigation should occur according to the Avifauna Monitoring Programme.
- Snakes & Reptiles
    - There are likely to be a variety of snakes present at the site including venomous species such as Puff Adder and Cape Cobra. They may be attracted to certain features such as buildings if these provide shelter or contain an abundance of prey species such as rodents.
    - Snakes encountered within the facility may pose a danger to staff and should be allowed to move off on their own in the case of snakes encountered on roads or other areas within

the ‘veld’ or be removed unharmed to safety by a suitably qualified person in the case where these pose a danger to humans.
    - All vehicles should give way to snakes and tortoises crossing roads. There are a lot of access roads at the site and reptiles will be crossing these on a regular basis and the potential for mortality resulting from being ‘run over’ is high. All vehicles should adhere to a low speed limit (<40km/h) and give way to all reptiles crossing the roads.
- Mammals
    - Resident fauna should not be habituated by feeding them scraps or other foodstuffs and it is not necessary to provide such species with water either as most arid fauna are independent of water. As such, it is also important that all waste at the site is handled appropriately and kept in closed bins not accessible to fauna.
    - Some species are vulnerable to being hit by motor vehicles including Steenbok, Bat-eared Fox, Hares and Riverine Rabbits. All vehicles on the site should adhere to a low speed limit (<40km/h) and give way to any mammals on the roads, especially if there is any driving on the site at night.
    - All incidents should be recorded on a log maintained by the Environmental Officer, so that additional mitigation measures can be implemented if there are any specific areas where regular incidents occur such as near river crossings where the abundance and activity of fauna is likely to be higher.
    - If there is any post-construction trenching or similar activity at the site, any trenches and holes excavated should not be left open for extended periods as fauna can fall in a become trapped. Trenches should have ramps of soil present where fauna can escape or should be excavated incrementally so that they are used only as required and do not stand open for extended periods.
- Riparian Habitat Protection
    - Alien plants, especially *Prosopis glandulosa* should be cleared from all drainage lines at the site as part of the environmental management of the site.
    - No water should be extracted directly from the rivers of the site. If water is required at the site, this should be obtained from existing dams or groundwater sources.
    - No wastewater or any potential pollutants should be discharged into the rivers or dams at the site.
- General Faunal Mitigation
    - Night-lighting at the site should be kept to a minimum. Artificial lights affect invertebrates and migrating birds and also attract bats and birds. If any parts of the site need to be lit at night for security or other reasons, then all lighting should be downward-directed low-UV type lights (such as most LEDs), which do not attract insects.
    - Any chemical, fuel, oil or other spills should be cleaned in the appropriate manner as related to the nature and extent of the spill. Contaminated soil should be removed from the site.
    - No parts of the site should be fenced with electrical fencing as this kills tortoises which come into contact the live wires.

Monitoring & Evaluation

- As the integrating framework for the environmental management of the site, the OSPM should ensure that all monitoring and associated record keeping is conducting according to the schedules of the respective subplans.
- As the issues at the site are likely to change over time, the OSMP should be evaluated on an annual basis for the three years of operation and then every 3 years or more regularly if required. Where specific problems arise, persons with relevant expertise should be brought in to advise the management of the site and update the OSMP.

APPENDIX K(F):
EROSION MANAGEMENT PLAN

PRINCIPLES FOR EROSION MANAGEMENT

1. PURPOSE

Exposed and unprotected soils are the main cause of erosion in most situations. Therefore, this Erosion Management Plan, the Storm water Management Plan and the Revegetation and Rehabilitation Plan are closely linked to one another and should not operate independently, but should rather be seen as complementary activities within the broader environmental management of the site and should therefore be managed together.

This Erosion Management Plan addresses the management and mitigation of potential impacts relating to soil erosion. The objective of the plan is to provide:

» A general framework for soil erosion and sediment control, which enables the contractor to identify areas where erosion can occur and is likely to be accelerated by construction related activities.
» An outline of general methods to monitor, manage and rehabilitate erosion prone areas, ensuring that all erosion resulting from all phases of the development is addressed.

This plan must be updated and refined once the construction/ civil engineering plans have been finalised following detailed design.

2. RELEVANT ASPECTS OF THE SITE

The proposed Witberg site is located on the rocky ridges of the Witteberg Mountain range, east of Touwsrivier, and just southwest of Matjiesfontein. The ridges are orientated in an east-west direction. The indigenous vegetation of the area includes Matjiesfontein Quartzite Fynbos which occurs on the ridges and Matjiesfontein Shale Renosterveld which occurs in the valleys between the ridges. Koedoesberge-Moordenaars Karoo dominates the lowlands of the north-eastern section of the site while Matjiesfontein Shale Fynbos occurs on the ridges and mountain slopes of the southern parts of the site.

Part of the site is located on a high ridge (that runs east-west) approximately 5 km south of the N1. The ridge is approximately 1,200 m to 1,400 m above sea level and is adjacent to a wide, open valley and smaller ridges to the north (within the site area). There are other ridges and rolling hills to the south of the site area (beyond the site boundary). The dominant orientation of all ridge lines in the area is parallel to the main ridge at the Witberg site; the site forms part of the Witteberg mountain range.

The high ground of the Witberg ridge is characterised by rocky outcrops, exposed boulders and rock pavements. There are steep sided slopes to the north and south of the main Witberg ridge and there is at lease one exposed cliff-face on the south side of the ridge. To the south of the site, rocks of the Cape Supergroup make up the Cape Fold Belt Mountains. Folding due to the tectonic forces that gave rise to the Cape Fold Belt is also present in the Study Area, deforming the local rocks, most of which belong to the Witteberg Group, which forms part of the Cape Supergroup. This group is subdivided into seven formations. The rocks associated with this group include shale, siltstone, mudstone and sandstone and conglomerate layers. The study area includes the Witberg, a prominent ridge rising some 500 m above the Matjiesfontein valley, along which runs the N1 and the main Cape Town—Johannesburg railway line. The western side of this ridge is affected by the proposed wind farm development. Both these ridges are anticlinal (U-shaped) structures, with exposed cores of erosion resistant sandstones of the Witpoort Formation (Dwi). These are flanked on their southern and northern sides by the more easily eroded, steeply dipping rocks of the Kweekvlei (Ck), Floriskraal (Cf) and Waaipoort Formations (Cw), all part of the Witteberg Group. The present access road from the N1 crosses low ridges of the Witteberg, Dwyka and Ecca Groups.

Due to the topography of the site and the high-ridge it is likely that the site lies within two or more watersheds. There are a number on nonperennial watercourses within the site area.

During construction, there will be a lot of disturbed and loose soil at the site which will render parts of the area vulnerable to erosion. Erosion is one of the greater risk factors associated with the development and it is therefore critically important that proper erosion control structures are built and maintained over the lifespan of the project.

Soil compaction and increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may potentially impact the downstream watercourses, wetlands and aquatic habitats, mainly due to an increase of surface water and silt inflow from the surrounding disturbed areas. These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.

3. EROSION AND SEDIMENT CONTROL PRINCIPLES

The goals of erosion control during and after construction at the site should be to:

» Protect the land surface from erosion;
» Intercept and safely direct run-off water from undisturbed upslope areas through the site without allowing it to cause erosion within the site or become contaminated with sediment; and
» Progressively revegetate or stabilise disturbed areas.

These goals can be achieved by applying the management practices outlined in the following sections.

3.1. On-Site Erosion Management

General factors to consider regarding erosion risk at the site includes the following:

» Due to the nature of soils in the study area, soil loss will be greater during dry periods as it is more prone to wind erosion. Therefore, precautions to prevent erosion should be present throughout the year.
» Soil loss will be greater on steeper slopes of the more easily eroded rocks. Ensure that steep slopes are not de-vegetated unnecessarily and subsequently become hydrophobic (i.e. have increased runoff and a decreased infiltration rate) increasing the erosion potential.
» Soil loss is related to the length of time that soils are exposed prior to rehabilitation or stabilisation. Therefore, the gap between construction activities and rehabilitation should be minimised. Phased construction and progressive rehabilitation, where practically possible, are therefore important elements of the erosion control strategy.

- The extent of disturbance will influence the risk and consequences of erosion. Therefore, site clearing should be restricted to areas required for construction purposes only. As far as possible, large areas should not be cleared all at once, especially in areas where the risk of erosion is higher.
- Roads should be planned and constructed in a manner which minimises their erosion potential. Roads should therefore follow the natural contour as far as possible. Roads parallel to the slope direction should be avoided as far as possible.
- Where necessary, new roads constructed should include water diversion structures with energy dissipation features present to slow and disperse the water into the receiving area.
- Roads used for project-related activities and other disturbed areas should be regularly monitored for erosion. Any erosion problems recorded should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.
- Runoff may have to be specifically channeled or storm water adequately controlled to prevent localised rill and gully erosion.
- Compacted areas should have adequate drainage systems to avoid pooling and surface flow. Heavy machinery should not compact those areas which are not intended to be compacted as this will result in compacted hydrophobic, water repellent soils which increase the erosion potential of the area. Where compaction does occur, the areas should be ripped.
- All bare areas should be revegetated with appropriate locally occurring species, to bind the soil and limit erosion potential.
- Silt fences should be used where there is a danger of topsoil or material stockpiles eroding and entering streams and other sensitive areas.
- Gabions and other stabilisation features must be used on steep slopes and other areas vulnerable to erosion to minimise erosion risk as far as possible.
- Activity at the site after large rainfall events when the soils are wet and erosion risk is increased should be reduced. No driving off of hardened roads should occur at any time, and particularly immediately following large rainfall events.
- Topsoil should be removed and stored in a designated area separately from subsoil and away from construction activities (as per the recommendations in the EMPr). Topsoil should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation in cleared areas.
- Regular monitoring of the site for erosion problems during construction (on-going) and operation (at least twice annually) is recommended, particularly after large summer thunderstorms have been experienced. The ECO will determine the frequency of monitoring based on the severity of the impacts in the erosion prone areas.

3.1.1. Erosion control mechanisms

The contractor may use the following mechanisms (whichever proves more appropriate/ effective) to combat erosion when necessary:

- Reno mattresses;
- Slope attenuation;
- Hessian material;
- Shade catch nets;
- Gabion baskets;
- Silt fences;

- Storm water channels and catch pits;
- Soil bindings;
- Geofabrics;
- Hydro-seeding and/or re-vegetating;
- Mulching over cleared areas;
- Boulders and size varied rocks; and
- Tilling.

3.2. Engineering Specifications

A detailed engineering specifications Storm water Management Plan describing and illustrating the proposed stormwater control measures must be prepared by the Civil Engineers during the detailed design phase and should be based on the underlying principles of the Storm water Management Plan (**Appendix I** of the EMPr) and this should include erosion control measures. Requirements for project design include:

- Erosion control measures to be implemented before and during the construction period, including the final storm water control measures (post construction).
- All temporary and permanent water management structures or stabilisation methods must be indicated within the Storm water Management Plan.
- An on-site Engineer or Environmental Officer (EO)/ SHE Representative to be responsible for ensuring implementation of the erosion control measures on site during the construction period. The ECO should monitor the effectiveness of these measures on the interval agreed upon with the Site Manager and EO.
- The EPC Contractor holds ultimate responsibility for remedial action in the event that the approved Storm water Management Plan is not correctly or appropriately implemented and damage to the environment is caused.

3.3. Monitoring

The site must be monitored continuously during construction and operation in order to determine any indications of erosion. If any erosion features are recorded as a result of the activities on-site the Environmental Officer (EO)/ SHE Representative (during construction) or Environmental Manager (during operation) must:

» Assess the significance of the situation.
» Take photographs of the soil degradation.
» Determine the cause of the soil erosion.
» Inform the contractor/operator that rehabilitation must take place and that the contractor/operator is to implement a rehabilitation method statement and management plan to be approved by the Site/Environmental Manager in conjunction with the ECO.
» Monitor that the contractor/operator is taking action to stop the erosion and assist them where needed.
» Report and monitor the progress of rehabilitation weekly and record all the findings in a site register (during construction).
» All actions with regards to the incidents must be reported on a monthly compliance report which should be kept on file for if/when the Competent Authority requests to see it (during construction) and kept on file for consideration during the annual audits (during construction and operation).

The Contractor (in consultation with an appropriate specialist, e.g. an engineer) must:

» Select a system/mechanism to treat the erosion.
» Design and implement the appropriate system/mechanism.
» Monitor the area to ensure that the system functions like it should. If the system fails, the method must be adapted or adjusted to ensure the accelerated erosion is controlled.
» Continue monitoring until the area has been stabilised.

4. CONCLUSION

The Erosion Management Plan is a document to assist the Proponent/ EPC Contractor with guidelines on how to manage erosion during all phases of the project. The implementation of management measures is not only good practice to ensure minimisation of degradation, but also necessary to ensure compliance with legislative requirements. This document forms part of the EMPr, and is required to be considered and adhered to during the design, construction, operation and decommissioning phases of the project (if and where applicable). During the construction phase, the contractor must prepare an Erosion Control Method Statement to ensure that all construction methods adopted on site do not cause, or precipitate soil erosion and shall take adequate steps to ensure that the requirements of this plan are met before, during and after construction. The designated responsible person on site, must be indicated in the Method Statement and shall ensure that relevant erosion control measures are in place throughout the construction phase.

An operation phase Erosion Management Plan should be designed and implemented if not already addressed by the mitigations implemented as part of construction, with a view to preventing the passage of concentrated flows off hardened surfaces and onto natural areas.

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APPENDIX K(G):
AVIFAUNA MONITORING AND MANAGEMENT GUIDELINES

BirdLife South Africa / Endangered Wildlife Trust

Birds and Wind-Energy Best-Practice Guidelines

Best-Practice Guidelines for assessing and monitoring the impact of wind-energy facilities on birds in southern Africa

Third Edition, 2015 (previous versions 2011 and 2012)

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Executive summary

The wind-energy industry is expanding rapidly in southern Africa. While experiences in other parts of the world suggest that this industry may be detrimental to birds (through the destruction of habitat, the displacement of populations from preferred habitat, and collision mortality with wind turbines, guyed masts and associated power lines), these effects are highly site- and taxon-specific. Raptors, large terrestrial species and wetland birds are likely to be most vulnerable, and areas of higher topographic relief are often implicated in negative impact scenarios.

In order to fully understand and successfully mitigate the possible impacts of wind energy on the region's birds (and to bring the local situation into line with international best practice in this field), it is essential that objective, structured and scientific monitoring of both resident and migrating birds be initiated at all proposed wind-energy development sites.

The Birds and Renewable Energy Specialist Group (BARESG), convened by the Wildlife and Energy Programme of the Endangered Wildlife Trust, and BirdLife South Africa, proposes the following guidelines and monitoring protocols for evaluating wind-energy development proposals, including a tiered assessment process as listed below.

(i) **Scoping** – a brief site visit informs a desk-top assessment of likely avifauna present, possible impacts, and the design of a site-specific survey and monitoring protocols.

(ii) **Pre-construction monitoring and impact assessment** – a full assessment of the significance of likely impacts and available mitigation options, based on the results of systematic and quantified monitoring.

(iii) **Construction-phase monitoring** - not always necessary, but can help determine if proposed mitigation measures are implemented and are effective, and identify triggers of any observed changes.

(iv) **Post-construction monitoring** – repetition of the pre-construction monitoring, plus the collection of mortality data, to develop a complete before and after picture of impacts, and refine mitigation measures.

(v) If warranted, more detailed and intensive research on affected threatened or potentially threatened species.

To streamline this approach, a shortlist of priority species should be drawn up at the scoping stage. Priority species should include threatened or rare birds, in particular those unique to the region, and especially those that may be susceptible to wind-energy impacts. These species should be the primary (but not the sole) focus of subsequent monitoring and assessment.

Similarly, the amount of monitoring effort required at each site should be set in terms of the anticipated sensitivity of the local avifauna and the prevalence of contributing environmental conditions (for example, the diversity and relative abundance of priority species present, proximity to important flyways, wetlands or other focal sites, and topographic complexity).

On-site work should be coupled with the collection of directly comparable data at a nearby, closely-matched reference (control) site where possible. This will provide much-needed context for the analysis of pre- vs. post-construction monitoring data.

In some situations, where proposed wind-energy developments are likely to impinge on flyways used by relatively large numbers of threatened and impact-sensitive birds, and particularly where these movements are likely to take place at night or in conditions of poor visibility (e.g. the Cape Columbine Peninsula), it may be necessary to use radar to gather sufficient information on flight paths to fully evaluate the development proposal and inform mitigation requirements.

Pre-construction monitoring will require periodic surveys of both the development and reference sites. These surveys should be sufficiently frequent to adequately sample all major variations in environmental conditions, with no fewer than four surveys spanning the annual cycle. Variables measured/mapped on each survey should include (i) density estimates for small terrestrial birds (in most cases not priority species, but potentially affected on a landscape scale by multiple developments in one area), (ii) census counts, density estimates or abundance indices for large terrestrial birds and raptors, (iii) passage rates of birds flying through the proposed development area (including nocturnal movements, where appropriate), (iv) evidence of breeding at any focal species sites, (v) bird numbers at any focal wetlands, and (vi) full details of any incidental sightings of priority species.

Post-construction monitoring should effectively duplicate the pre-construction monitoring work, with the addition of surveys for avian collision victims under the turbines, and collision and electrocution victims under the ancillary power infrastructure. Estimates of fatality rates should take into account scavenger removal and searcher efficiency.

While analysis and reporting on an individual development basis will be the responsibility of the relevant avifaunal specialist, all data emanating from the above process should also be housed centrally by BARESG and/or the South African National Biodiversity Institute (SANBI) to facilitate the assessment of results on a multi-project, landscape and national scale.

These guidelines will be revised periodically as required, based on experience gained in implementing them, and on-going input from various sectors. This is the third edition.

A list of qualified avian specialists who have agreed to adhere to these guidelines is available at www.birdlife.org.za and www.ewt.org.za.

Forewords:

The South African Wind Energy Association and the Best Practice Guidelines

The South African Wind Energy Association (SAWEA) has been involved as a stakeholder in 2015 revision of the Birds and Wind-Energy Best-Practice Guidelines. SAWEA supports the development (and periodic revision) of a best practice guideline that is in line with international best practice standards in avian monitoring and impact assessment for wind farm projects, and is practical and pragmatic in its approach.

The Birds and Wind-Energy Best-Practice guidelines have been designed over a number of years with the specific objective of ensuring that wind farm developments are done with full care for birds and responsibility towards their wellbeing. Specific attention has been afforded to species that may be sensitive to the potential impacts of wind farms, and those of conservation concern. In order for wind energy projects to be developed in a sustainable manner it is important that the objective of protecting these species is met.

The continued development of a sustainable and environmentally sensitive wind energy industry in South Africa can only be achieved through responsible and careful development. In order to ensure wind development that is harmonious with bird life populations the implementation of a robust pre-construction (baseline) bird monitoring programme is required to highlight potential development risks, to inform development design, and also to inform any Environmental Impact Assessment process. In many cases, with robust baseline data and a good understanding of the site-specific conditions with regards to bird populations and activity, potential impacts can be mitigated through designing a development with a focus on removing, reducing or avoiding potential impacts to birds as far as possible. Appropriate data collection during construction and during the first years of wind farm operation are also important.

As such, SAWEA supports the implementation of these guidelines at all proposed wind energy developments.

Johan Van den Berg, SAWEA CEO

BirdLife South Africa and the Best Practice Guidelines

Our country is in an energy crisis. We need to increase our capacity to generate electricity and at the same time we must to reduce our dependence on non-renewable forms of energy generation. Harnessing the wind's energy is an obvious and attractive option. A growing wind energy industry in South Africa is now a reality and the Renewable Energy Independent Power Producer Procurement Programme has won international acclaim.

BirdLife South Africa welcomes the positive contribution wind energy can make towards climate change mitigation; climate change is a significant threat to the environment, and will affect many of our bird species. However, wind energy is not without environmental impacts and we remain concerned about the potential impacts our birds may face as a result of this technology. Data from a handful of European and American sites demonstrate clearly that wind farms can adversely affect bird populations if they are built in the wrong places.

Despite these concerns, we believe that if we apply the lessons learned by our colleagues in other parts of the world, and work openly with the relevant stakeholders, we can substantially reduce these negative effects. We have obtained advice and assistance from our partners in European countries where wind energy development is already quite advanced. We have also collaborated with the Wildlife and Energy Programme of the Endangered Wildlife Trust (EWT-WEP), and engaged directly with local developers, environmental assessment practitioners and specialist ornithologists alike in our efforts to address this looming problem. In particular, we sincerely appreciate the ongoing inputs of the experts on the Birds and Renewable Energy Specialist Group who contributed to these Best Practice Guidelines and continue to guide our work.

What we have learned is that effective mitigation of the impacts of wind energy on birds is largely about understanding bird movements through the affected area, and the corresponding placement of turbines in the landscape to avoid high-risk areas. These Best Practice Guidelines outline what is required to develop this understanding.

Wind energy is new in South Africa and our ability to accurately predict and prevent impacts on birds is likely to be imperfect. It is therefore critical that we gather data at operational facilities so that any unanticipated negative impacts are identified and dealt with. This will also allow us to develop our knowledge around how best to ensure the sustainability of future wind farms. Post-construction monitoring was therefore a major focus in this revision of the Guidelines.

BirdLife South Africa is committed to provide up-to-date advice to help ensure that wind energy South Africa is as sustainable as possible. The Best Practice Guidelines, which are regularly updated and draw heavily on international best practice and research, demonstrate this commitment. In turn, we believe that a commitment from stakeholders to adhere strictly to these Guidelines, and to engage in an open and transparent manner, will help ensure that impacts on birds are limited to acceptable levels. The quality of environmental impact assessments for proposed wind energy developments has increased dramatically since the first edition of these Guidelines was released and we look forward to this positive trend continuing.

Mark Anderson, CEO Birdlife South Africa

The Endangered Wildlife Trust and the Best Practice Guidelines

The Endangered Wildlife Trust (EWT) has been pioneering Conservation in Action since 1973. In this time, the EWT has been at the forefront of developing innovative, strategic partnerships with various industries to develop proactive mitigation measures to reduce harmful impacts on our environment, and to catalyse best management practices throughout the sector which reduce wildlife losses.

With the emergence of wind generated power as a key element in our future energy mix, we have the perfect opportunity to stay ahead of the game, and to apply best practice proactively in the development of wind farms and their associated infrastructure. This latest edition of the guidelines will further expand our scope to include operational challenges faced by the industry such as mortality estimates and mitigation and we will continue to adapt as we learn more about the impact of wind energy.

We acknowledge the importance of wind generated power as a crucial component of a climate friendly energy production mix, but also recognise the potential negative impacts of the infrastructure on certain species of birds and bats. Unfortunately, the emergence of this possible new threat to our avifauna comes at a time when birds globally are declining in conservation status and where South Africa has among the highest number of birds at risk of extinction in Africa. We therefore continue working tirelessly to ensure that wind farm development and operation in South Africa poses as little threat as possible to our birds and to the environment at large.

In this context, the EWT is proud to be working with long-standing partner BirdLife South Africa and a range of new collaborators in the wind energy sector to develop these best practice guidelines, which aim to ensure that the development and operation of wind energy facilities takes place sustainably, and without detrimentally affecting the region's birds.

Yolan Friedmann, CEO Endangered Wildlife Trust

Glossary of terms and acronyms

Accuracy	The degree to which the result of a measurement and/or calculation aligns with the true value (accuracy is different to precision, which is a measure of how close different measurements are to each other).
Adaptive management	An iterative decision-making process used in the face of uncertainty where management policies and practices are continually improved through monitoring and learning from the outcomes of previous approaches.
BARESG	The Birds and Renewable Energy Specialist Group, a group of bird specialists who guide the work of BirdLife South Africa and the Endangered Wildlife Trusts relevant to birds and wind energy (formerly the Birds and Wind Energy Specialist Group, BAWESG).
Bird habitats	Habitats available and important to birds, usually shaped by factors such as vegetation, topography, land use and sources of food and water.
BIRP	Birds in Reserves Project, a project run by the Animal Demography Unit (University of Cape Town) that collects bird occurrence data inside South African protected areas. For more information visit http://birp.adu.org.za.
Broader impact zone	The area in which potentially impacted birds are likely to occur. This will extend beyond the development footprint/development area, but should be included in monitoring and impact assessment surveys. This could include the considerable space requirements of large birds of prey.
CAR	Coordinated Avifaunal Roadcounts, a programme where large terrestrial birds are monitored from vehicles along fixed routes. See http://car.adu.org.za for more information.
Commercial Operation Date	The date on which all of the turbines and associated infrastructure necessary to put the WEF into operation and transmit power have been tested and commissioned, and the WEF is authorized and able to start producing electricity for sale.
Cumulative impact	Impacts on a species, ecosystem or resource as a result of the sum of actions in the past, present and foreseeable future, from multiple WEFs or a WEF in combination with other developments.
CWAC	Coordinated Waterbird Counts, a programme of bird censuses at a number of South African wetlands. See http://cwac.adu.org.za for more information.
Developable area	The area in which wind turbines, and associated road and power infrastructure might be located.
Impact zone	Usually taken to mean the area directly impacted by development, e.g. the development footprint (compare to "broader impact zone")
IBA	Important Bird and Biodiversity Area (formally know as Important Bird Area).
Important Bird (and	Part of a global network of sites that are critical for the long-term

Biodiversity) Area	viability of bird populations. Now known as Important Bird and Biodiversity Areas. See www.birdlife.org.za/conservation/important-bird-areas for more information.
Large WEF	The number and installed capacity of wind turbines, as well as their spatial distribution influence the size of a WEF. For the purposes of this guideline, a large WEF is considered to be greater than 140 MW.
Priority species	Threatened or rare birds (in particular those unique to the region and especially those which are possibly susceptible to wind-energy impacts), which occur in the given development area at relatively high densities or have high levels of activity in the area. These species should be the primary (but not the sole) focus of all subsequent monitoring and assessment.
Red flag	A warning signal, which in the context of these guidelines would indicate that the impacts of a WEF on birds (or their habitats) are likely to be unsustainable.
Reference site	An area that is similar to the development site and that is monitored together with the development site in order to provide a baseline against which the impacts of the development can be compared. A reference (or control) site is a critical part of a Before (pre-construction)-After (post-construction) –Control (reference site)-Impact (development) (BACI) approach.
Rotor-swept area	The area of the circle or volume of the sphere swept by the turbine blades
SABAP	The Southern African Bird Atlas Project. A project in which data on bird distribution and relative abundance are collected by volunteers. There have been two SABAP projects; i.e. SABAP1 (completed in 1991) and SABAP2 (started in 2007 and on-going). The unit of data collection for SABAP2 is a pentad (five minutes of latitude by five minutes of longitude). See http://sabap2.adu.org.za for more information.
Significant impacts	Impacts the effects of which are likely to persist for a long time, will affect a large area, or extend far beyond the area in which the activity occurs. Where species are concerned, significant impacts would be those that negatively affect the conservation status of a population at a given scale. Where possible, impacts should be contextualised in terms of the distribution, abundance, population size and current mortality rates or levels of threat of bird species. Population modelling (beyond the scope of these guidelines) may be useful to help determine the significance of impacts for some species.
Small WEF	A WEF that does not require environmental authorisation for electricity generation. At the time of writing this threshold is 10MW.
Wind-energy facility	A power plant that uses wind to generate electricity, also colloquially known as a wind farm.
WEF	A wind-energy facility.

1. Introduction

KEY POINTS

- Renewable energy has the potential to play a significant role in mitigating global climate change, but renewable energy can also have negative environmental impacts.
- Wind energy can impact on birds directly by injuring or killing birds that collide with the wind turbines and associated infrastructure. It can also impact on birds indirectly, for example by creating a barrier to movement, displacing sensitive species, affecting breeding success and/or altering habitat.
- These guidelines were developed to ensure that negative impacts on threatened or potentially threatened bird species are identified and mitigated using structured, methodical and scientific methods.
- A multi-tiered approach is proposed with the overarching aims of: 1) informing current environmental impact assessment processes, 2) developing our understanding of the effects of wind-energy facilities on southern African birds, and 3) identifying the most effective means to mitigate these impacts.

Human-induced climate change is increasingly recognised as a significant threat to the natural environment (e.g. Thomas et al., 2004; Foden et al., 2013). Renewable energy has the potential to play a significant role in mitigating global climate change and can therefore make a positive contribution to the conservation of birds and other biodiversity. However, renewable energy can also have negative environmental impacts.

The wind-energy industry is in the process of rapid expansion in southern Africa. Credible, scientific studies in other parts of the world have established that the most prevalent impacts of wind-energy facilities (WEFs) on birds are displacement of sensitive species from development areas, and mortality of susceptible species, primarily in collisions with development hardware (for reviews of these studies see Drewitt & Langston 2006; Drewitt & Langston 2008; Jordan & Smallie 2010; Strickland et al. 2011; Rydell et al. 2012; Gove et al. 2013).

The nature and extent of these impacts is highly dependent on both site- and species-specific variables (Drewitt & Langston 2006; Jordan & Smallie 2010; Gove et al. 2013 and references therein). At this stage, there is no empirically based understanding of the likely effects of wind-energy development on southern African birds. The South African Birds and Renewable Energy Specialist Group (BARESG) therefore recognizes the need to measure these effects as quickly as possible, in order to identify and mitigate any detrimental impacts on threatened or potentially threatened species. BARESG also recognizes the need to gather these data in a structured, methodical and scientific manner, in order to arrive at tested and defensible answers to critical questions (Stewart, Pullin & Coles, 2007).

Data collection should be done by means of an integrated programme of pre-construction (baseline) monitoring and impact assessment, and post-construction (operational-phase) monitoring set up at all the proposed development sites. Given the rate and extent of proposed wind-energy development, these studies should be done as quickly as possible, but using scientific methods to generate accurate, comparable information. The current set of best-practice guidelines presents the means and standards required to achieve these aims.

These guidelines propose a multi-tiered approach, with the overarching aims of:

a) informing current environmental impact assessment processes;
b) developing our understanding of the effects of wind energy on southern African birds; and
c) identifying the most effective means to mitigate these impacts.

These guidelines are intended to be a living document that will be updated and supplemented over time, as local specialists and research practitioners gain much-needed experience in this field.

This is the third edition of the guidelines. Changes from the previous version are summarised below.

a) The layout of the text has been changed; summaries to highlight critical points have been added at the beginning of each section.
b) The use of terminology is more consistent.
c) The recommended timing of monitoring and link to the environmental impact assessment process has been clarified.
d) It has been clarified that the guidelines set out the minimum requirements for most WEFs and in many cases the scope of work may need to be extended.
e) Additional detail has been provided with regards to vantage-point monitoring. The recommendation with regards to distance between vantage points has been corrected (areas surveyed from vantage points should have a radius of 2 km, not be 2 km apart as was indicated in the previous edition).
f) Recommendations with regards to tracking birds with satellite devices have been included.
g) Additional detail has been provided on collision-risk modelling.
h) Recommendations with regards to construction-phase monitoring have been clarified.
i) Additional detail has been provided on post-construction monitoring (the timing, duration and nature of monitoring).
j) Recommendations with regards to fatality estimates have been included.
k) Recommendations on peer review have been included.
l) Appendices have been added (minimum requirements for impact assessment and recommended (generic) conditions of approval).

2. Recommended protocols

KEY POINTS

- Monitoring and decision-making should follow a tiered approach:
  - *Stage 1, **scoping**, should inform project screening or the scoping phase of the impact assessment.*
  - *Stage 2, **pre-construction monitoring and avifaunal impact assessment,** informs the impact assessment and decision-making process and provides a baseline against which post-construction monitoring can be compared.*
  - *Stage 3, **construction-phase monitoring**, may be necessary to monitor and mitigate impacts during construction.*
  - *Stage 4, **post-construction monitoring** is necessary to document impacts and identify if additional mitigation is required.*
  - *Stage 5, detailed research to address specific questions, may be required where there is a need to understand and mitigate particular impacts.*
- Monitoring effort should be proportional to the size of the proposed WEF, topographic and/or habitat heterogeneity on site, the relative importance of the local avifauna, and the anticipated susceptibility of the relevant birds to the potential negative impacts.
- These guidelines set out the minimum requirements for monitoring; in some instances more work may be necessary to provide sufficient information for decision-making. The designated avifaunal specialist should determine the scope of work, based on site-specific information, best available science, and stakeholder input.
- Monitoring should focus mainly on a shortlist of priority species, although it is also necessary to monitor the distribution, abundance and potential displacement effects on populations of small birds.
- Each project should provide quantitative information on the abundance, distributions and risk to key species or groups of species, and serve to inform and improve mitigation measures.

A tiered approach to survey and monitoring should be adopted, similar to that that has been applied in both Europe and North America (e.g. Scottish Natural Heritage 2005; Kuvlesky et al. 2007; U.S. Fish and Wildlife Service 2012).

The first tier, scoping, could be undertaken as part of the project screening (i.e. before the EIA process), but must be included in the scoping phase of the impact assessment process. Should the scoping report endorse the development, a full avian impact assessment should then be based on the second tier of work (i.e. pre-construction monitoring). Pre-construction monitoring is central to the impact assessment process (i.e. the impact assessment is based on information collected during pre-construction monitoring) and should be used to determine: 1) if the project should proceed, 2) what mitigation measures are necessary, and 3) the nature and extent of construction-phase and post-construction (operational-phase) monitoring.

Should the avian impact assessment also endorse the proposed development and it goes ahead, a third tier of work could consist of construction-phase monitoring (where required). Post-construction monitoring must follow this.

At selected sites where bird impacts are expected to be particularly direct and severe (in terms of the relative biodiversity value of the affected avifauna, and/or the inherent risk potential of the proposed facility), additional, more customized and experimental research initiatives may be required, such as intensive, long-term monitoring of populations (Strickland et al., 2011), for example using satellite tags (e.g. Nygård et al. 2010). However, these additional studies may not always help reduce potential impacts to acceptable (sustainable) levels.

Monitoring should also be undertaken at a minimum of one nearby reference (control) site, matched as closely as possible to the proposed development site, to validate before-after comparisons of bird populations.

2.1. Stage 1: Scoping

KEY POINTS

- The aim of scoping is to: 1) define the study area, 2) characterise the site, 3) provide an initial indication of the likely impacts of the facility, and 4) determine the scope of pre-construction monitoring/avifaunal impact assessment.
- Scoping should include a desktop study using existing information, as well as a short site visit.
- The study area should be defined during scoping and should extend beyond the boundaries of the development footprint itself.
- Bird abundance and activity monitoring should focus data collection on priority species, but potential impacts on small and/or common species should not be overlooked.
- The resulting scoping report should describe birds potentially impacted and the nature of that risk. It should also highlight if there are any obvious red flags to development.
- The scoping report should describe the effort required for pre-construction monitoring and impact assessment.
- The avifaunal scoping report must be included in the scoping phase of impact assessment, but could also be used in project screening, before initiating a formal EIA.

2.1.1. Aims of scoping

The main aims of a scoping study are discussed below.

i. **To define the study area** - the area covered by each proposed development is determined by the project developer, and comprises the inclusive area on which development activities (the construction of turbines and associated road and electrical infrastructure) are likely to take place. However, because birds are highly mobile animals, and because an important potential impact is the effect of the WEF on birds that move through the proposed development area, as well as those which are resident within it, the avian impact zone of any proposed WEF extends well beyond the boundaries of this central core. Of particular concern is that monitored areas are large enough to include the considerable spatial requirements of large birds of prey, which may reside tens of kilometres outside of the core development area, but regularly forage within it (Walker et al. 2005; Madders & Whitfield 2006). How far the study area extends in each case should be determined by the avifaunal specialist, and should be defined at the scoping stage of the assessment process, perhaps with opportunity for subsequent refinement during the impact assessment.

   Generally, the extent of the broader impact zone of each project will depend on the dispersal abilities and distributions of important populations of priority species that are likely to move into the core impact area with some regularity. It is important that the delineation of this impact zone, which is the area within which all survey and monitoring work will be carried out (not including the reference site), is done realistically and objectively, balancing the potential impacts of the WEF with the availability of resources to conduct the monitoring.

ii. To **characterize the site** in terms of:
   - the bird habitats present (habitats available and important to birds, usually shaped by factors such as vegetation structure, surface water, topography, land use and food sources),
   - a list of species likely to occur in those habitats,
   - a list of priority species likely to occur, with notes on the value of the site and surrounding areas for these birds,
   - input on likely seasonality of presence/absence and/or movements for key species, and
   - any obvious, highly sensitive, no-go areas to be avoided by the development from the outset (these could be landscape-scale features that may influence the location of the entire WEF, or finer-scale features that should guide micro-siting of turbines).

iii. To provide an initial estimation of **likely impacts** of the proposed WEF.

iv. To **determine the nature and scale of pre-construction monitoring** required to measure these impacts, and to provide input on mitigation.

In summary, scoping should yield a scoping report, which should describe the avifauna at risk, detail the nature of that risk, and discuss options for mitigation. The report should also outline the pre-construction monitoring effort required to inform the avian impact assessment report and highlight any red flags to development.

2.1.2. Information sources used in scoping

Scoping should be based on data sources such as those presented below.

i. A **desktop study** of the local avifauna, using relevant, pre-existing information and datasets - for example
   a. *Roberts Birds of Southern Africa, 7th Edition* (Hockey, Dean & Ryan, 2005) and other relevant avian handbooks, field guides and publications;
   b. The *Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* (Taylor, 2015);
   c. The BirdLife South Africa/Endangered Wildlife Trust avian wind farm sensitivity map for South Africa (Retief et al., 2012);
   d. The Southern African Bird Atlas data (SABAP 1 - (Harrison et al., 1997), and SABAP 2, http://sabap2.adu.org.za);
   e. Coordinated Waterbird Counts (CWAC, http://cwac.adu.org.za, Taylor et al. 1999);
   f. Coordinated Avifaunal Roadcounts (CAR, http://car.adu.org.za, Young et al. 2003);
   g. Birds in Reserves Project (BIRP, http://birp.adu.org.za);
   h. Important Bird Areas initiative (Barnes, 1998); (IBAs, http://www.birdlife.org.za/conservation/important-bird-areas,
   i. Data from the Endangered Wildlife Trust's programmes (www.ewt.org.za) and associated specialist research studies; and
   j. Monitoring and impact assessment reports for nearby wind farms that are in the public domain.

ii. A short (2-4 day) **site visit** to the area to search for key species and resources, and to develop an on-site understanding of where (and possibly when) priority species (see section 2.1.3) are likely to occur and move around the site. Note that such a single visit will not allow for investigation of seasonal variation in the composition and behaviour of the local avifauna, and such variation must therefore be estimated in terms of existing information for the site or region, and the experience of the consulting specialist.

2.1.3. Priority species

Bird abundance and activity monitoring should focus data collection on a shortlist of priority species, defined in terms of (i) threat status or rarity (see Barnes 2000 and Taylor 2014), (ii) uniqueness or endemism, (iii) susceptibility to disturbance or collision impacts, and (iv) relative use of the site. High relative use could be as a result of usage by a relatively small number of individuals of a priority species, (e.g. breeding raptor), or use by large numbers of different bird species. These species should be identified in the scoping/avian impact assessment specialist report and/or by the BirdLife South Africa/EWT sensitivity mapping exercise (Retief et al. 2012 or updates thereof). This will generally result in a strong emphasis on large, Red-Data species (e.g. cranes, bustards and raptors – Drewitt & Langston 2006; 2008; Jenkins et al. 2010).

While immediate conservation imperatives and practical constraints encourage focus on priority species, it is also important to account for subtler, systemic effects of wind-energy developments, which may be magnified over very large facilities, or by multiple facilities in the same area. For example, widespread, selective displacement of smaller, more common species by WEFs may ultimately be detrimental to the status of these birds and, perhaps more significantly, may upset the balance and effective functioning of the local ecosystem. Similarly, the loss of relatively common but ecologically pivotal species (e.g. non-threatened predators such as Jackal Buzzard (*Buteo rufofuscus)*, Rock Kestrel (*Falco rupicolus*) and Black-shouldered Kite (*Elanus caeruleus*) from the vicinity of a WEF may also have a substantial, knock-on ecological effect. Hence, some level of monitoring of small-bird and ecologically pivotal bird populations will be required at all sites, and certain non-threatened, but impact-susceptible species will emerge as priority species by virtue of their perceived value to the ecosystem. Also note that quantitative surveys of small-bird populations may be the only way in which to adequately test for impact phenomena such as displacement (Devereux, Denny & Whittingham, 2008; Farfán et al., 2009), given that large-bodied target species occur so sparsely in the environment that it may not be possible to submit density or abundance estimates to rigorous statistical examination.

Ultimately, each monitoring project should provide much-needed quantitative information on the numbers, distributions and risk profiles of key species or groups of species within the local avifauna at a given development site, and serve to inform and improve mitigation measures designed to reduce this risk, including possible identification of unsuitable areas for WEFs.

2.1.4. Timing

Whilst the avifaunal scoping study could coincide with and serve as the scoping study for the purposes of EIA, it is not necessary to wait until the formal EIA starts in order to start monitoring. It may prove to be valuable for developers to commission an avifaunal scoping study (or screening study) prior to initiating a formal impact assessment process as this might help avoid unnecessary investment in unsuitable sites. Developers are also encouraged to consult with BirdLife South Africa, EWT, and other experts, as early on in the project development cycle as possible.

2.1.5. Reporting (Avifaunal Scoping Report)

The Avifaunal Scoping Report should include a description of the nature and extent of the study area, a preliminary indication of the potential impacts and any no-go areas, and outline the proposed approach to monitoring and impact assessment. The Avifaunal Scoping Report should be included in the formal Scoping Report for the WEF.

2.2. Stage 2: Pre-construction monitoring and impact assessment

KEY POINTS

- Pre-construction monitoring provides: 1) a basis for avifaunal impact assessment and 2) a baseline against which the results of post-construction (operational phase) monitoring can be compared.
- Bird species richness and passage rates should also be monitored at a reference (control) site to help understand the causes of any changes observed (i.e. environmental conditions vs. impacts of the WEF itself).
- Pre-construction monitoring data should be collected over a 12 months period and should include samples representative of the full spectrum of environmental conditions likely to occur within the annual cycle. Surveys should be as frequent as practically possible, with a minimum of four surveys a year.
- Before monitoring commences, the avian habitats present at the project and reference sites should be mapped using available information (e.g. satellite images and GIS data).

Number and density of small birds:

- The species richness, density and/or relative abundance of small birds can be surveyed using walked transects, fixed-point counts and checklist surveys. All major habitat types within the impact zone should be sampled in proportion to their availability on site. Checklist surveys are suitable for monitoring species in the broader impact zone of the affected area of the WEF, but must be complemented by transect or fixed-point counts.

Number of large terrestrial birds:

- The numbers of large terrestrial birds should be estimated on each visit, using census counts (small WEFs) or by road counts (large WEFs). Any breeding pairs and/or nest sites of priority species located during this survey work must be plotted and treated as focal sites for subsequent monitoring.

Focal point surveys:

- Nest sites of large terrestrial species and any habitats likely to support nest sites of key raptors should be surveyed and carefully checked on each site visit to confirm occupancy. Any signs of breeding should be recorded.
- Wetlands should be identified, mapped and surveyed for waterbirds on each survey, using the standard protocols set out by the CWAC initiative.
- Guyed masts (and powerlines) should be checked for signs of bird collisions; the findings should be recorded as with collision-victim surveys in the post-construction phase.
- Incidental sightings of priority species, particularly if suggestive of breeding, important feeding or roosting sites, or flight paths, should be recorded.

Bird movements:

- Understanding bird movements at a site requires significant time and effort, but it can be critical to inform the impact assessment and mitigation strategy.

- Vantage-point surveys should provide information on the time spent flying over the development area, the relative use of different parts of the area, and the proportion of time different species spend flying at different heights (e.g. above, below and through the rotor-swept area).
- A maximum radius of 2 km should be surveyed from each vantage point.
- Vantage points should be positioned to aim for maximum coverage of the developable area. Overlapping viewsheds should be avoided, or accounted for in the later analysis.
- A minimum of 12 hours should be spent at each vantage point each season (winter, spring, summer and autumn) and should include all times of day (dawn, midday, late afternoon). This time may need to be increased if collision-prone priority species may be impacted.
- The use of radar or other technology to record bird movements should be considered, particularly where detailed data on bird movements is required, or where movements occur at night or in conditions of poor visibility (e.g. fog). Radar cannot easily distinguish between different species, however, and should be used in combination with direct observations (wherever possible).
- The use of bird-borne tracking devices (e.g. satellite/GSM) could also be considered as this can provide valuable data on the preferred foraging ranges and movement corridors of individual birds. Devices must be deployed prudently to minimise impacts on the subject.

Impact assessment:

- The avifaunal impact assessment should include an analysis of the data collected from scoping and pre-construction monitoring surveys.
- The results of this analysis should inform the turbine layout, as well as the assessment of the significance of the potential impacts of the proposed project alternatives (with and without mitigation).
- The impact assessment should detail the nature and extent of monitoring required during construction and operation of the facility.
- Sufficient data should be gathered on bird movements, to enable the use of the data in collision-risk modelling to provide an indication of the potential mortality rates of priority species.

2.2.1. Aims of pre-construction monitoring and impact assessment

The six primary aims of pre-construction monitoring and impact assessment are listed below.

i. To determine the species richness and abundance of birds regularly present or resident within the broader impact area of the WEF before its construction.
ii. To document patterns of bird movements in the vicinity of the proposed WEF before its construction.
iii. To estimate predicted collision risk (the frequency with which individuals or flocks fly through the future rotor-swept area of the proposed WEF – Morrison 1998; Band et al. 2007) for key species.
iv. To inform the environmental impact assessment report and related decisions.
v. To mitigate impacts by informing the final design, construction and management strategy of the development.
vi. To establish a baseline of bird species richness, abundance, distributions and movements.

Pre-construction monitoring serves a dual function. It is necessary to inform the impact assessment process, but it also provides a baseline against which the results of post-construction monitoring can be assessed. Data on species richness, abundance and distribution are necessary to assess the sensitivity of birds to disturbance and displacement. Data on species' movements will give an indication of collision risk and potential displacement.

2.2.2. Timing of study

Scoping and pre-construction monitoring are required to guide and inform the avian impact assessment report. Pre-construction monitoring should therefore be completed before the impact assessment is finalised.

If there is a significant gap (i.e. more than three years) between the completion of the initial pre-construction monitoring and impact assessment, and the anticipated commencement of construction, it may be advisable to repeat the pre-construction monitoring (or parts thereof) to assess whether there have been any changes in species abundance, movements and/or habitat use in the interim.

2.2.3. Reference (control) sites

Reference (control) sites are essential for a Before-After-Control-Impact (BACI) approach and to enable a distinction to be made between effects likely attributable to a wind farm and those stemming from other factors (Anderson et al., 1999). Identifying suitable reference sites may be challenging, but monitoring of bird species richness, relative abundance, and passage rates, should be undertaken for both the broader impact zone of the proposed WEF and for one or more comparable reference sites. In this way, a comparison of data from pre-construction and post-construction monitoring can be calibrated in terms of an equivalent comparison for a suitable reference area, and the effects of regional variation in environmental conditions can be filtered out of the resulting quantification of the actual impacts of the WEF (Anderson et al. 1999; Stewart et al. 2007; Pearce-Higgins et al. 2009; Scottish Natural Heritage 2009). Proposed WEF sites in close proximity to one another could use a common reference site (or sites) to minimize time and effort in this regard

Reference sites should match as closely as possible the impact site in all respects, most notably suitable reference sites should:

i. be located on ground with a similar mix of habitats (e.g. vegetation, wetlands, etc.), altitude, topography and slope aspects (Pearce-Higgins et al., 2009);
ii. host a similar mix of bird species to those present on the WEF site;
iii. be at least half the size of the WEF; and
iv. be situated as close as possible to the WEF area, but far enough away to ensure that resident birds on the reference site are not directly affected by the wind farm operations once they start, and also that there is little, if any, localised movement of key species between the two areas.

2.2.4. Duration

Fieldwork should be conducted over a period spanning at least 12 consecutive calendar months to include sample counts representative of the full spectrum of prevailing environmental conditions likely to occur on each site in that period (Drewitt & Langston, 2006). While fieldwork need not span a full 365 days, the duration should be timed to ensure that the full annual cycle is represented. This time-span may not have direct biological relevance, but presents a compromise between the extremes of either attempting to accommodate inevitable and probably significant variation between years (of particular relevance in arid environments), or distilling the process into a very short sampling window.

The duration of fieldwork should be extended where there is a high risk of significant impacts on priority species and:

i. there is likely to be strong inter-annual variation in the presence and movement of priority species (see for example Gove et al. 2013); or
ii. there is a high degree of uncertainty related to the potential impacts and/or mitigation measures required, and further monitoring would help reduce this uncertainty.

2.2.5. Frequency and timing of surveys

Surveys should be timed to include sample counts representative of the full spectrum of prevailing environmental conditions likely to occur in a 12 month period (Drewitt & Langston, 2006). The quality and utility of the monitoring data is generally proportional to sampling frequency, so the number of iterations of each sampling technique per survey, and the number of surveys per year, should always be kept at a practical maximum. Practical constraints (e.g. human capacity, size and accessibility of the site, time, and finances) may modulate the frequency of surveys; four visits to the site within an annual cycle should be considered as an absolute minimum for achieving adequate coverage. No less than 20% of the total time spent in the field should occur in any three consecutive calendar months.

2.2.6. Habitat classification and mapping

Before sampling and counting commence, the study area should be defined and avian habitats available on both the project and the reference sites should be mapped using a combination of satellite imagery (Google Earth) and GIS tools. These maps should later be subject to ground-truthing and refinement according to on-site experience and/or the findings of scoping phase botanical and wetland surveys.

2.2.7. Bird species richness and abundance

Bird population monitoring may present some challenges. Proposed developments can cover very large areas, many of the priority species are large birds (e.g. cranes, bustards, eagles and vultures) that have proportionally large spatial requirements and sparse distributions (Jenkins, 2011) and some of the key species are nomadic, with fluctuating densities related to highly stochastic weather events that drive local habitat conditions. Furthermore, some of the proposed development sites are situated in remote and rugged terrain, and access limitations may preclude uniform and/or random sampling of all habitats. Hence sampling methods and sample sizes may be determined as much by what is practically possible as by what is required for statistical rigour. However every effort should be made to cover a representative cross-section of the available habitats, or at least to sample those areas most likely to hold priority species.

In this context, and within these limitations, it remains a stringent requirement that bird species richness, abundance, distributions and activities are monitored as accurately as possible at all proposed WEF and reference sites, including data for a representative range of avian guilds.

The main concern for comparative studies is that the same techniques are used throughout the pre- and post-construction monitoring at any given site. It is therefore important that the details of the survey protocols are carefully and clearly documented.

Note that a heavy reliance on recording bird species by their vocalizations in pre-construction surveys may preclude direct comparison of such data with that collected in post-construction monitoring, when the noise of the operating turbines may significantly reduce an observer's ability to hear, locate and identify calling birds. It is therefore important to document whether birds recorded were heard or seen in order to facilitate later analysis of pre- and post-construction data in the face of such a potential difficulty.

(a) Small terrestrial species

While the emphasis of any monitoring project should be on the priority species identified at the scoping stage (and any other threatened and/or restricted-range endemics seen and added to this list subsequently), it is also necessary to monitor the distribution, abundance and potential displacement effects on populations of small birds, even when these do not include species prioritized by the scoping exercise. This is more to further our understanding of the general effects of WEFs, and in particular the possible cumulative impacts of widespread WEF development on the broader avifauna, than to fulfil any immediate and localized conservation requirement. Given the potentially very large area that will be devoted to wind-energy development in 10-20 years' time (http://www.sawea.org.za/), we need to assess now whether or not components of communities of small birds are likely to be displaced, before these developments result in potential landscape-scale distributional and abundance changes, with the longer-term ecological damage that such changes could bring.

The abundance of small birds can be determined either by estimating actual measured densities, i.e. absolute abundance, or, more crudely, by merely measuring relative abundance. The latter does not provide a measure of the actual numbers/densities of birds present; rather it provides a relative measure of abundance to compare bird abundances across different sites or time periods. Walked transects and fixed-point counts are examples of techniques producing estimates of densities/actual numbers. A so-called 'Kilometric Abundance Index' (KAI) and relatively crude checklist surveys are examples of techniques generating relative measures of abundance. It should be noted that techniques producing absolute-abundance estimates are typically more complex to carry out, both in the field and in subsequently analysing the data, than techniques generating relative-abundance measures. As a general statement, techniques designed for measuring relative abundances are suitable for monitoring species in the broad "affected area" of the WEF, but should be complemented by walked-transect or fixed-point counts conducted within the turbine-development area.

It is also critically important to appreciate that the relationship between absolute densities/numbers and measures of relative abundance of birds is unlikely to be linear in nature (e.g. Jakob and Ponce-Boutin 2013 and references therein). This means that changes as gauged by measuring relative abundances likely represent far greater changes in terms of absolute densities/populations (i.e. monitoring initiatives rooted in measures of relative abundances are more likely to under-estimate, and even fail to detect, changes as estimated by techniques based on estimates of absolute abundance).

(i) Walked transects

Small birds can be monitored by means of walked, linear transect methods in open habitats (Leddy et al. 1999; Bibby et al. 2000). The length, number and distribution of these transects on each site may vary according to site size, habitat diversity, and the richness and relative significance of the small terrestrial avifauna. Ideally all the major habitat types present should be sampled approximately in proportion to their availability on site. Transects should be positioned at varying distances away from the proposed turbine arrays to maximize the value of the data in comparison with results from surveys made during the post-construction phase. It is preferable to have many fairly short (e.g. 200 m) transects than few long (e.g. 2 km) transects.

Transects should be surveyed according to standard procedures (for example, as described by Emlen 1977; O'Connor & Hicks 1980; Ralph and Scott 1981; Bibby et al. 2000). These procedures should take into account possible biases caused by factors such as different observers, time of day, bird song activity, weather conditions, seasonality, differences in interspecific detectability, etc. As a general rule, transects should not be walked in adverse conditions, such as heavy rain, strong winds or thick mist.

Transect counts aimed at estimating the density/absolute numbers of birds present at a site typically require measurement/estimation of the perpendicular distance from the transect line of all birds recorded. This should either be measured by range-finder, estimated by eye (in which case calibration is necessary), or estimated in terms of pre-selected distance bands (e.g. 0-10 m, 11-50 m, 51-200 m, >200 m), and recorded for subsequent analysis using the computer programme DISTANCE (Buckland et al. 2001; Thomas et al. 2010), or equivalent approaches (Bibby et al. 2000; Newson et al. 2008).

Alternatively, transects can be done with a fixed maximum width, and only birds seen or heard within this distance on either side of the transect line should be recorded (e.g. Leddy et al. 1999). These methods yield estimates of density (birds/km^{-2}), but do not take the probability of detection into account. The 'Kilometric Abundance Index' (KAI) (Vincent, Gaillard & Bideau, 1991; Acevedo et al., 2008; Preatoni et al., 2012) is an example of a 'transect-count-type' method that provides a relative measure of bird.

WALKED TRANSECTS
Recommended variables to record for each transect include*:

- Project name
- Transect number
- Date
- Observer/s
- Start/finish time
- GPS location at start and finish or track log
- Orientation of transect
- Distance covered (m)
- Habitat type/mix of habitat types
- Gradient of slope (flat, gentle, steep)
- Aspect of slope (none, north, north-east, east…)
- Temperature at start
- Cloud cover at start
- Wind strength/direction at start
- Visibility at start and end of survey (good, moderate, poor)

- Position of sun relative to direction of walk (ahead, above, behind)

And, whenever possible, variables to record for each observation should include:

- Time
- Species
- Number (number of adults/juveniles/chicks)
- Activity (flushed, flying-display, flying-commute, perched-calling…)
- Seen or heard?
- GPS on transect line
- Distance and direction from observer
- Perpendicular distance off transect line (m) (if required)
- Distance band off the transect line (if required)
- Fixed transect width (if required)
- Plot on map
- Additional notes

** Many of these variables can be recorded before or after the site visit using GIS.*

(ii) Fixed-point counts

Another acceptable way to measure the densities of small birds, especially in densely vegetated habitats such as forest, is to use fixed-point counts (Bibby et al., 2000). For fixed-point counts the observer is positioned at one fixed location (chosen either randomly or systematically to ensure coverage of all available habitats), and records the species and sighting distance of all birds seen and heard over a prescribed period of time. (Bibby et al., 2000)

Again, survey locations should be selected to represent the habitats covered more or less in proportion to their availability. The duration of each count period should be long enough to detect a representative sample of birds within the survey area, but short enough to avoid including birds that were not present in the area at the start (e.g. 5-10 minutes). As with line transects, the distance from the static observer to each bird or flock of birds registered can either be measured directly (by estimation or using a laser range-finder), or allocated to a range of circular bands of distance from the observer, or else the count can be done with a fixed-detection radius, including only the birds seen within this distance (Bibby et al., 2000). It is important to record whether birds are seen or heard, as it may be difficult to hear birds once the WEF is operational.

FIXED POINT COUNTS

Recommended variables to record for each such fixed-point count include:

- Project name
- Fixed-point number
- Date
- Observer/s
- Start/finish time
- GPS location
- Habitat type/mix of habitats
- Gradient of slope (flat, gentle, steep)
- Aspect of slope (none, north, north-east, east…)
- Temperature at start
- Cloud cover at start
- Wind strength/direction at start
- Visibility at start (good, moderate, poor)

And, whenever possible, variables to record for each observation should include:

- Time
- Species
- Number (number of adults/juveniles/chicks)

- Activity (flushed, flying-display, flying-commute, perched-calling…)
- Seen or heard?
- Distance to bird (m) (if required)
- Distance band containing bird (if required)
- Fixed radius of count (m) (if required)
- Additional notes

(iii) Checklist surveys

A further method of documenting the occurrence and relative abundance of small terrestrial species (although in this instance, all species are included in the data-collection protocol) is the "checklist survey". This method does not measure the absolute abundance (density) of species, but provides a measure of relative abundance based on the "reporting rate". In its simplest form, the reporting rate is the proportion of checklists for a particular area that record a particular species relative to the total number of relevant checklists completed for the area expressed as a percentage.

The objective of checklist surveys and analysis is to provide a simple comparison of relative abundance, per species, between the pre- and post-construction phases. The advantage of the checklist survey is that the method is easy to implement in situations where methods of counting birds may be difficult to apply in a consistent manner, for example, where habitats are diverse or visibility limited, and the survey area is very large (Royle & Nichols, 2003; Joseph et al., 2006). A disadvantage is that it is dependent on not one, but a series of checklists (preferably at least 10), recorded at different times, so that a robust relative-abundance statistic can be calculated. Checklist surveys are suitable for monitoring species in the broad "affected area" of the WEF, but must be complemented by transect and/or fixed-point counts conducted at varying distances from the turbines. The latter counts will provide a more sensitive measure of density at the localities most likely to be impacted by the turbines.

The protocol for a checklist survey requires (a) the definition of a survey area (to permit comparable repeat visits), (b) the application of a constant amount of survey effort, and (c) coverage of all habitat types within the survey area. All species encountered are recorded as present only, i.e. individuals of each species are not counted. In addition, the order in which species are first observed is recorded, as well as the total number of new species per hour of observation. The minimum amount of time allocated to each checklist should be sufficient to permit coverage of all the habitat types in the survey area (two hours is the specified minimum in the SABAP2 protocol, with a maximum of five days). Note that while larger species and priority species should be included in checklist surveys, these do not replace other methods of measuring the density of these birds, which include the capture of critical information on absolute rather than relative abundance (although see Wenger & Freeman 2008).

Where possible and appropriate, the protocols used by SABAP2 (the second Southern African Bird Atlas Project) should be used. Details of these protocols are available on the project's website (http://sabap2.adu.org.za/). For SABAP2, the survey area is the "pentad", a 5x5-minute grid resulting in a cell of roughly 8x9 km. The size of a pentad makes it advisable to survey it using a vehicle to cover the area. Pentads could be suitable survey areas for large WEFs, particularly if the WEF is located centrally within the pentad, and the data collected will be compatible with the SABAP2 database. Every pentad that includes a portion of the WEF should be surveyed, as a minimum.

Relatively small WEFs would perhaps be better served by transect or point counts, or by using grid cells smaller than those used by SABAP2.

(b) Large terrestrial species and raptors

Large terrestrial birds (e.g. cranes, bustards, storks, and most raptors) cannot be adequately surveyed using walked transects. Populations of such birds should be estimated on each visit to the project area either by means of a census (only possible at relatively small proposed WEFs) or by means of road counts (vehicle-based sampling; best applied at relatively large proposed WEFs, especially those with good networks of roads and tracks). Any obvious breeding pairs and/or nest sites located during this survey work should be plotted and treated as focal sites for subsequent monitoring (see below). Malan (2009) provides particularly comprehensive coverage of raptor surveying techniques within a South African context. The road infrastructure and accessibility of the site is likely to change if the WEF becomes operational. It is therefore important to carefully record the survey methods and survey effort to allow for later comparison.

(i) Census counts

Census counts of priority species involves searching as much of the broader impact area of the WEF (or the reference site) as possible in the course of a day, using the available road infrastructure and prominent vantage points to access and scan large areas, and simply tallying all the individuals observed. This is only practical for the largest and most conspicuous species, and probably is only effective for cranes and bustards. If necessary, counts can be standardized for observer effort (time, area scanned, methods used), but ideally they will be working estimates of the total number of each target species present within the study area on that sampling day.

CENSUS COUNTS OF LARGE PRIORITY SPECIES

Recommended variables to record for each count of large, priority species include:

- Project name
- Count number
- Date
- Observer/s
- Start/finish time
- Temperature at start
- Cloud cover at start
- Wind strength/direction at start
- Visibility at start (good, moderate, poor)

And, whenever possible, variables to record for each observation should include:

- Time
- Species
- Number (number of adults/juveniles/chicks)
- Activity (flushed, flying-display, flying-commute, perched-calling…)
- Flight direction (if required)
- Flying height (if required - above, below or within rotor-swept area)
- GPS location of observer
- Distance and direction from observer
- Plot birds sighted on map and/or record GPS points
- Habitat type/mix of habitats
- Gradient of slope (flat, gentle, steep)
- Aspect of slope (none, north, north-east, east…)
- Seen close to (feedlot, dam, river-course, ridge or cliff-line…)
- Seen while driving/walking/scanning
- Additional notes

(ii) Road counts

Road counts of large terrestrial birds and raptors require that one or a number of driven transects be established (depending on site size, terrain and infrastructure), comprising one or a number of set routes, limited by the existing roadways but as far as possible directed to include a representative cross section of habitats within the impact zone. These transects should be driven at a constant and slow speed, and all sightings of large terrestrial birds and raptors should be recorded in terms of the same data-capture protocols used for walked transects (above), and in general compliance with the road-count protocols described for large terrestrial species (Young et al., 2003) and raptors (Malan, 2009). In addition, each transect should include a number of stops at vantage points to scan the surrounding area. If sighting distance is used to delineate the area sampled, this method will yield estimates of density (birds/km^{-2}) for all large terrestrial species and birds of prey. Alternatively, variation in sighting distances (perhaps associated with variable terrain or habitat) may preclude the use of this method, and it may only be possible to determine a simple index of abundance, expressed as the number of birds seen per kilometre driven (birds/km).

ROAD COUNTS

Recommended variables to record for driven transect counts of large terrestrial species and raptors include:

- Project name
- Transect number
- Date
- Observer/s
- Start/finish time
- GPS location at start/finish
- GPS location of vantage points
- Odometer reading at start/finish
- Distance covered (km)
- Temperature at start
- Cloud cover at start
- Wind strength/direction at start
- Visibility at start (good, moderate, poor)

And, whenever possible, variables to record for each observation should include:

- Time
- Species
- Number (number of adults/juveniles/chicks)
- Activity (flushed, flying-display, flying-commute, perched-calling…)
- Flight direction (if required)
- Flying height (below, above or within rotor-swept area)
- Seen while driving/scanning?
- Habitat type/mix of habitat types
- Gradient of slope (flat, gentle, steep)
- Aspect of slope (none, north, north-east, east…)
- Seen close to (feedlot, dam, river course, ridge or cliff-line…)
- GPS on transect line
- Perpendicular distance off transect line (m) (if required)
- Distance band off the transect line (if required)
- Fixed transect width (if required)
- Plot on map
- Additional notes

(iii) Focal-site surveys and monitoring

Nest sites

Any habitats within the broader impact zone of the proposed WEF, or an equivalent area around the reference site, deemed likely to support nest sites of key raptor species (including owls) - cliff-lines or quarry faces, power lines, stands of large trees, marshes and drainage lines - should be surveyed following protocols in Malan (2009) in the initial stages of the monitoring project. All such sites should be mapped accurately, and checked on each visit to the study area to confirm continued occupancy, and to record any evidence of breeding, and where possible, the outcomes of such activity, that may take place over the survey period (Scottish Natural Heritage, 2010). Disturbance of breeding birds must be kept to a minimum during surveys.

Any nest sites of large terrestrial species (e.g. bustards and especially cranes) that may be located should be treated in the same way, although out of season surveys are unlikely to yield results as these birds often do not hold year-round territories.

Evidence of breeding should be assigned the same status categories as used in SABAP2.

NEST SITE SURVEYS
Recommended variables to record for each nest site survey should include:

- Project name
- Date
- Observer/s
- Species
- Site name, number or code
- Type of site (nest, roost, foraging…)
- Time checked
- Temperature
- Cloud cover
- Wind strength/direction
- Visibility (good, moderate, poor)
- Signs of occupation (e.g. fresh droppings, fresh food remains, freshly moulted feathers)*
- Signs of breeding activity (e.g. adults at nest, adult incubating or brooding, eggs or nestlings)*
- Number of adults/eggs/nestlings/juveniles seen*
- Additional notes

** Evidence of breeding should be summarised and reported using SABAP2 codes (i.e. CDP – courtship display, CAN - adult bird carrying nesting material, ANB - active nest building, NCN – newly completed nest, NWE - nest with eggs, NWC - nest with chicks, PFY – parents feeding young in nest, PFS - parents with fecal sac, PAY - parents and young not in nest, JUV – juvenile birds).*

Wetlands

The major wetlands on and close to the development area should also be identified, mapped and surveyed for waterbirds on each visit to the site, using the standard protocols set out by the CWAC initiative (Taylor et al., 1999). Some priority species (e.g. Blue Cranes, *Anthropoides paradiseus*) may only occupy wetland roosts at night; suspected roosts should therefore be visited late in the day to tally the numbers of birds as they accumulate into the evening.

WETLAND SURVEYS
Recommended variables to record for each wetland survey should include:

- Project name
- Date
- Observer/s
- Wetland name, number or code
- Time at start/finish of count
- GPS location at observation point
- Temperature
- Cloud cover
- Wind strength/direction
- Visibility (good, moderate, poor)

- Tidal state (if wetland is tidal)

And, whenever possible, variables to record for each species counted should include:

- Species
- Number (number of adults/juveniles/chicks)
- Direction of arrival/departure from wetland (if applicable)
- Activity (e.g. feeding, roosting, transit)
- Additional notes

Guyed masts and power lines

As an extension of the focal-site monitoring, any guyed masts within the proposed development area should be checked each survey iteration for signs of bird collisions, and the findings should be recorded as per post-construction collision-victim surveys (see below). Other infrastructure that may pose a collision risk (for example power lines) should also be checked as far as possible, particularly where collision-prone priority species are potentially affected. Any carcasses found beneath power lines should be reported to the Eskom / EWT Incident Reporting Hotline (0860 111 535, email wep@ewt.org.za)

(iv) Incidental observations

All other, incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area should be carefully plotted and documented. These could include details of nocturnal species (especially owls) heard calling at night.

INCIDENTAL OBSERVATIONS
Recommended variables to record for each incidental observation of priority species should include:

- Project name
- Date
- Observer/s
- Time
- Temperature
- Cloud cover
- Wind strength/direction
- Visibility (good, moderate, poor)
- Species
- Number (number of adults/juveniles/chicks)
- Activity (flushed, flying-display, flying-commute, perched-calling…)
- Flight direction (if required)
- Flying height (if required - <30m, 30-150m, >150m)
- GPS location of observer
- Plot birds sighted on map
- Habitat type/mix of habitats
- Gradient of slope (flat, gentle, steep)
- Aspect of slope (none, north, north-east, east…)
- Seen close to (feedlot, dam, river course, ridge or cliff-line…)
- Seen while driving/walking/scanning
- Additional notes

2.2.8. Bird movements

A spatially explicit understanding of bird movements in and around a proposed WEF site may be more important to determine the sustainability of the project (and identify an effective mitigation strategy) than knowledge of the species richness and abundance of birds present. Developing such an understanding requires a significant investment of time and effort. Vantage-point surveys are the primary means of gathering data on bird movements, but in some instances these direct observations may benefit from supplementary data from remote sensing equipment (e.g. radar) and bird-tracking devices. The designated avifaunal specialist should determine the need for supplementary data, with input from relevant experts and stakeholders (e.g. EWT and BirdLife South Africa).

(a) Direct observation/vantage point surveys

The purpose of vantage point watches is to collect data on priority species to allow estimation of:

i. the time spent flying over the proposed development area;
ii. the relative use of different parts of the development area;
iii. the proportion of flying time spent within the upper and lower height limits as determined by the rotor diameter and rotor-hub height of the turbines to be used (rotor-swept area); and
iv. the flight activity of other bird species using the development area.

Counts of bird traffic over and around a proposed/operational facility should be conducted from suitable vantage points. The same vantage-point locations should be used for each subsequent survey, as even small changes in observer position can affect results (Scottish Natural Heritage, 2013).

Vantage-point watches should be designed so as to obtain a representative sample of bird movements across a development site. The vantage points chosen should provide an overview of as much of the development area as possible using the minimum number of vantage points (Scottish Natural Heritage 2013). GIS can be used to facilitate the identification of vantage points with the best inclusive viewsheds. Overlapping viewsheds should be avoided, or where this is not possible, any overlap should be accounted for in later analysis.

Ideally, to achieve seamless coverage, all areas of the potential development area of the WEF should be within a 2 km radius of a vantage point (Gove et al., 2013; Scottish Natural Heritage, 2013). This distance may be stretched if conditions (visibility) allow, although the accuracy of the height and distance estimates may be compromised, and smaller species may be overlooked. Where complete coverage is not possible (e.g. some very large and topographically varied sites) a minimum of 75% of the potential developable area should be surveyed.

As an absolute minimum, each vantage point should be surveyed for 12 hours per season, spread across the period from before dawn to after dusk. Vantage point watches should be divided into three or more shifts (e.g. dawn, midday and dusk), and these shifts should be between two to three hours each. Ideally vantage point watches should be spread over multiple days (i.e. the same vantage point should not be surveyed more than once a day). This will allow activity between different days to be accounted for and will increase the representativeness of the data. This may however prove impractical at vantage points that are difficult to reach. Scheduling should always take the detrimental effects of observer fatigue on data quality into consideration.

Where flight activity is very varied, or if there is a risk of significant negative impacts to a priority species more observation time is likely to be necessary to obtain a representative sample of flight patterns. This is especially important in areas where flocking species such as vultures, cranes or pelicans are present, or where turbines are placed within the territory of a priority species.

Additional observation time may be necessary to obtain a clear indication of collision risk (Gove et al., 2013).

It may be useful to schedule additional vantage-point monitoring at particular times of day or seasons to coincide with the times a particular species of concern is most active, if a particular risk has been identified that requires further investigation. Night-time watches, coincident with clear, moonlit conditions, might be valuable at sites where nocturnal activity is considered potentially relevant. Kunz et al. (2007) provide a good overview of methods and tools to study nocturnal movements of birds.

Observation and data collection should ideally be focused in the direction of the proposed development area from the vantage point, extending to 90^{o} on either side of that focal point, i.e. an 180° field of observation. Bird movement taking place outside this view ('behind') the observers may be relevant, and should be included at the discretion of the site specialist or the fieldworkers at the time, but not at the expense of effective 'forward' coverage. Where a team of two observers are working together at a single vantage point, a viewshed larger than 180° (even up to 360^{o}) may be possible. Where the activity of target species is low and visibility is good, it may also be possible for a single observer to accurately cover 360^{o}. As with all survey methods, clearly written documentation, describing what has been done, is essential.

Vantage-point surveys require many hours on site collecting data and the resulting tedium can constrain the quantities of data that can be accumulated. Other challenges include the inability to gather meaningful movement data at night or in daytime conditions of low visibility, and the risk that the relatively limited sampling periods will miss or under-represent episodic mass movements of birds (Scottish Natural Heritage, 2013).

VANTAGE POINT SURVEYS

Recommended variables to record for each vantage point survey should include:

- Project name
- Vantage point name/number
- Date
- Observer/s
- Start/finish time
- GPS location
- Temperature at start
- Cloud cover at start
- Wind strength/direction at start#
- Visibility at start (good, moderate, poor)

And, whenever possible, variables to record for each observation should include:

- Time sighted and time bird moved out of view
- Species
- Number (number of adults/juveniles/chicks) at start and end of observation
- Temperature
- Cloud cover
- Wind strength/direction#
- Visibility (good, moderate, poor)
- Initial sighting distance (m)
- Flight mode (direct commute-flapping, direct commute-gliding, slope soaring…)*
- Underlying habitat*
- Gradient of underlying slope (flat, gentle, steep)*
- Aspect of slope (none, north, north-east, east…)*
- Flight direction*

- Flying height (below, above or within rotor swept area))*
- Identifiable flight path indicators (valley, neck or saddle, ridge line, thermal source…)
- Plot on map
- Additional notes

**These variables should ideally be recorded at 15-30 second intervals from the initial sighting, or at least with every change in flight mode, until the bird/flock of birds is lost.*
 # Wind data can be measured directly using a hand-held anemometer, and/or sourced from the wind data collected on-site by the developer for the relevant date and time.

(b) Radar

The state of the art in monitoring bird movements in relation to WEFs involves the use of custom-built radar installations (e.g. http://www.detect-inc.com/wind.html and http://echotrack.com). When set up correctly, these systems can provide round-the-clock coverage of a sizeable area in all weather conditions. Radar systems cannot easily distinguish between different species, types or even sizes of birds, but when used in combination with direct observation to calibrate remotely collected information, they can provide comprehensive and accurate data describing the frequency, height and direction of bird flight paths through a proposed or operational wind farm.

While costly, use of a radar system is likely to add significant value to any monitoring project, and may be essential at certain sites where it is critical to obtain accurate data on large-scale movements of birds, or movements of significant numbers of highly threatened species, that are thought (or known) to take place at night or in conditions of poor visibility. For example, many of the larger-scale movements made by waterbirds typically occur at night and our current understanding of the routes followed is extremely poor. The Cape West Coast area between Langebaan, Vredenburg and Velddrif is one example where radar monitoring may provide valuable additional data on the night-time movements of waterbirds. Such information can be vital to ensuring that wind-energy development in such areas proceeds sustainably.

(c) Tracking devices

The use of tracking devices (e.g. satellite/GSM devices) attached to birds can help provide a better understanding of the flight behaviour and habitat usage of individual birds. Data arising from bird-borne telemetry could be useful in determining the placement of wind turbines and may also provide useful insights into flight behaviour of individual birds before and after construction (Gove et al., 2013).

It is, however, important to be cognisant of the limitations of tracking data, particularly with regards to accuracy of the data, the frequency with which location data is recorded, the duration of study, and the number of individual birds tracked in relation to the size of the affected population. For example, if location data is recorded every 30 minutes this may give a good indication of the bird's range/territory size, but is unlikely to give a good indication of the actual flight patterns and whether the bird was travelling within the rotor-swept area. Further, only individual birds can be monitored, meaning that typically not all birds using an area are assessed. It is therefore important that the appropriate technology is selected, and that it is able to provide adequate data to meet the objectives of the study (Strickland et al., 2011).

Handling birds and attaching devices to them carries an inherent risk to study animals. There is some evidence of negative impact on birds fitted with tracking devices (Marzluff et al., 1997; Gregory, Gordon & Moss, 2003; Phillips, Xavier & Croxall, 2003). These risks must be minimised as far as possible and deployment of devices must be justified in terms of the science and conservation outcomes expected. Consideration should also be given to alternative methods to obtain the data (U.S. Fish and Wildlife Service, 2013).

Permits for fitting tracking devices must be obtained from the relevant provincial conservation authority. It is recommended that ethical clearance should also be obtained for the project from a relevant ethics committee. When projects are linked to academic institutions, ethical clearance can be obtained directly from the ethics committee of the particular academic institution. Should the project not be linked to an academic institution, it is recommended that the research proposal is submitted to the BirdLife South Africa Ethics Committee for review.

A competent person who is experienced in the fitting of tracking devices must be involved in the project. It is the responsibility of both the specialist and person fitting the device to ensure that the impact on the bird be kept to a minimum, both during the fitment process and subsequently. A device should never weigh more than 2-3% of the body weight of the individual bird on which it is deployed (Phillips, Xavier & Croxall, 2003). The device should be tested prior to deployment and attachment systems (e.g. use of harnesses) should first be tested on captive birds before a bird in the wild is fitted with a tracking device if the relevant species has not been tracked before or a novel harness fitting is considered.

For more information please see BirdLife South Africa's position statement on the tracking of birds, available at www.birdlife.org.za.

2.2.9. Impact assessment

The avifaunal impact assessment should be based on data collected from the pre-construction surveys detailed above. The impact assessment must include consideration of the eight key aspects presented below (with appropriate mapping and statistical analyses, where relevant).

i. A comprehensive list of the bird species recorded (or expected to occur) at the relevant sites (including control sites), including details of local distribution (with spatial mapping where appropriate), confirmed and predicted breeding status (again with spatial mapping where appropriate), gross habitat preferences, seasonality, endemism and Red-data status (both globally and nationally). This information should clearly differentiate between species positively recorded at the site by the specialist team, recorded in the general or specific area by other projects (e.g. SABAP, CWAC, CAR, etc.) and species not yet recorded in the area at all, but predicted to occur or possibly occur. This information should also identify and justify priority species.
ii. Absolute and relative abundance estimates and measures for small terrestrial birds, through linear transect surveys and fixed-point counts, and checklist surveys.
iii. Counts, density estimates and abundance indices for large terrestrial birds and raptors;
iv. Flight behaviour of priority species flying above, below or through the rotor swept area and associated risk of collisions (see below).
v. Evidence of breeding at any focal nest sites.
vi. Bird numbers at any focal wetlands and local movements between waterbodies.
vii. Full details of any incidental sightings of priority species.
viii. Collision mortalities related to any existing guyed lattice masts and existing power lines.

This information should be used to cover six primary requirements as outlined below.

i. Determine whether or not the proposed development (or parts thereof) is fatally flawed and should not be recommended for approval.
ii. Develop a topographical map indicating the area that is expected to be impacted by the proposed development alternatives, and the location of key habitats and flyways that should not be developed or otherwise transformed.
iii. Inform the final turbine layout (or where the layout cannot be finalized within the EIA, the assessment should be used to define no go areas and areas that should be sufficiently buffered).
iv. Assess the significance of the potential impact of the proposed project alternatives and related activities - with and without mitigation - on avifaunal species and communities (with regards to potential disturbance, displacement, habitat loss and mortality through collision), including consideration of the spatial and temporal extent of these impacts.
v. Inform actions that should be taken to avoid or, if avoidance is not feasible, to mitigate and minimize negative impacts during the planning, construction and operational phases of the development.
vi. Inform the nature and extent of monitoring required during the post-construction phase.

The framework used for assigning significance values should be clearly described in the report, and should include consideration of the probability, extent, duration, magnitude and certainty of impacts. Unacceptable negative impacts would be those impacts that diminish the conservation status of a species or population. Where possible, impacts on a given taxon should be contextualised in terms of the size and distribution of the affected population, and any known trends in key demographic parameters. This may require the use of population models.

A map indicating the location of vantage points and the viewshed from each vantage point should be provided, together with a map of the proposed turbine layout.

The avifaunal impact assessment must include a description of the limitations and assumptions of the assessment.

Where other developments are proposed in a region, the impact assessment must include consideration of cumulative impacts. Bellebaum et al. (2013), for example, indicated that while collision risk at each turbine was small and relatively low levels of mortality were observed at individual wind farms, the cumulative impact of wind farms in Germany could negatively influence the local population of Red Kites (*Milvus milvus)*. When considering cumulative impacts, the distribution, spatial requirements and population dynamics of potentially affected priority species should be considered, together with the likelihood of impacts from other proposed developments.

(a) Collision risk

Assessment of collision risk may be qualitative or quantitative. Data from vantage-point surveys can be used to develop an index of collision risk for different areas within the developable area. Alternatively, if sufficient data are available the number of bird fatalities that might take place once the wind farm is operational could be estimated using a collision-risk model (Band, Madders & Whitfield, 2007; Scottish Natural Heritage, 2009; Strickland et al., 2011; U.S. Fish and Wildlife Service, 2012). There are different approaches to modelling collision risk (e.g. Podolsky 2004; Band et al.

2007), but most models take into account characteristics of the wind facility and its turbines, as well as the passage rate, height and speed of flight, and use a correction factor to account for uncertainties and behaviour (avoidance) (Strickland et al., 2011). The latter approach (i.e. estimating fatalities) is strongly recommended where there is a high risk of priority species being affected, but input data must represent average conditions if the output is to be meaningful. Input data must represent the range of conditions/seasonal variation in usage and it may be appropriate to run the collision model several times to account for marked spatial or temporal variation in bird presence/behaviour.

Collision-risk models make a number of assumptions, including predictions of species-specific bird behaviour (Madders & Whitfield, 2006). They assume that mortality risk increases with flight activity and bird abundance, but evidence to support this assumption is equivocal (Gove et al., 2013) and a number of other factors are likely to influence collision risk (de Lucas et al., 2008; Ferrer et al., 2012). For example, collision risk might be reduced if birds are displaced by the WEF (U.S. Fish and Wildlife Service, 2013). Flights of large bird species below the rotor-swept area could also be 'at-risk' flights, as large birds may change flying trajectories and go into the rotor-swept area quite quickly (Á. Camiña. pers. comm.).

Collision-risk models can provide a useful basis on which to compare different wind farms (Chamberlain et al., 2006; Gove et al., 2013) or different layouts. However, the limitations of the input data (for example, the degree to which the data represent average conditions, or the accuracy of the flight-height estimates) and the limitations of the model should always be borne in mind (Chamberlain et al., 2006). The outputs of collision-risk models must be compared with fatality data collected on site after construction to validate the model (U.S. Fish and Wildlife Service, 2012) and improve correction factors/avoidance rates used.

2.3. Stage 3: Construction-phase monitoring

The construction phase of a WEF is likely to be the most intense period in terms of disturbance and displacement of birds. It is important to gain a better understanding of how WEF construction impacts on birds, and how these impacts can be minimised (Pearce-Higgins et al., 2012).

Construction-phase monitoring can be used to:

a) determine if the proposed mitigation measures (e.g. buffers) are implemented by the developer, and whether or not they are effective in minimising impacts on sensitive birds during construction;
b) provide insights into the triggers and duration of any observed changes in species presence, abundance and behaviour; and
c) provide an opportunity to gather additional data on priority species and focal points (particularly where nest sites have been identified).

Construction-phase monitoring will not be necessary for all wind farms, but could be recommended by the specialist in the impact assessment if there is a focal site of specific interest or concern, and/or if there is a need to gather additional data on a species potentially affected by the WEF. Construction-phase monitoring is likely to be recommended if there are anticipated impacts on the breeding of priority species.

If the specialist recommends construction-phase monitoring, the duration, frequency and scope of work should be outlined in the impact assessment report and included in the environmental management plan. Without pre-empting the recommendations of the specialist, surveys of approximately three days per season, with a particular focus on focal-point surveys, could be anticipated.

Specialists are also encouraged to check for carcases beneath turbines and other infrastructure. These searches do not necessarily need to follow the rigorous protocols outlined for post-construction monitoring, but may shed valuable insights into the impacts of the facility before the Commercial Operation Date is reached.

Depending on the nature and scope of the work required the avifaunal specialist team and/or a suitably qualified environmental control officer could undertake construction-phase monitoring. The results of this monitoring should inform any additional mitigation that may be required and should be included in revisions of the environmental management programme.

2.4. Stage 4: Post-construction monitoring

KEY POINTS

- Post-construction monitoring is necessary to: a) determine the actual impacts of the WEF, b) determine if additional mitigation is required at the WEF, and c) improve future assessments.
- Post-construction monitoring does not negate the need to first avoid, then minimise and lastly mitigate negative impacts during the project-development stage.
- Post-construction monitoring should start on, or soon after the Commercial Operation Date.
- Post-construction monitoring can be divided into three categories: a) habitat classification, b) quantifying bird abundance and movements (replicating pre-construction monitoring), and c) quantifying bird mortalities.
- There are three components to estimating fatality rates: a) estimation of searcher efficiency and scavenger removal rates, b) carcass searches, and c) estimation of collision rates.
  - *All turbines should be searched for fatalities, with a search interval determined by scavenger-removal trials and objectives monitoring. Two complementary search protocols should be applied: 1) intensive and regular searches of a minimum of 30% or 20 turbines at a WEF (which ever is greater), and 2) extensive, less frequent sampling of the remaining turbines to record fatalities of large-bodied birds. The search area must be defined and consistently adhered to throughout monitoring. As a minimum, the radius of the search area be should equal to 75% of the turbine height (ground to blade-tip).*
  - *Observed mortality rates must to be adjusted to account for searcher efficiency, scavenger removal and the probability that some carcasses may be outside the search area.*
- The duration and scope of post-construction monitoring should be reviewed annually Post-construction monitoring of bird abundance and movements should span a minimum of two years. Surveying the WEF for fatalities should also be done for a minimum of two years after construction, and should be repeated again at year five, and every five years thereafter. The outcomes of the previous years monitoring, together with the sensitivity of the receiving environment should guide if specific components of monitoring should be extended beyond the prescribed minimum.

2.4.1. Aim of post-construction monitoring

Avifaunal impact assessments rely on a number of assumptions. The pre-construction monitoring protocols outlined in this document represent a compromise between practicality (time and cost) and statistical rigour. Relying on imperfect data and research findings from different regions (and often different species) means that there will always be a degree of uncertainty and risk associated with assessments.

Post-construction monitoring is therefore critical to:

i. determine the actual impacts of the WEF;
ii. determine if additional mitigation is required (adaptive management); and
iii. improve future assessments.

By committing to post-construction monitoring developers will help facilitate the development of a sustainable wind-energy industry and reduce risks and costs to both the environment and the industry in the long run.

Post-construction monitoring should assess if there are any changes in: a) habitat available to birds in and around the WEF, b) abundance and species composition of birds, c) movements of priority species, and d) breeding of priority species. It should also provide an indication of fatality rates as a result of collisions with the turbines and associated infrastructure, and if there are spatial, temporal or conditional patterns to the frequency of collisions. Lastly, post-construction monitoring should highlight if additional mitigation is required to reduce impacts to acceptable levels.

Commitment to post-construction monitoring does not negate the need to firstly avoid, secondly minimise and finally mitigate negative impacts identified in the impact assessment, but it can help lessen unanticipated negative impacts. Post-construction monitoring is particularly important given the heavy reliance on adaptive management that characterises many environmental impact assessments for WEFs in South Africa.

Post-construction monitoring can be divided into three categories: a) habitat classification, b) quantifying bird numbers and movements (replicating pre-construction monitoring), and c) quantifying bird mortalities. It may be necessary to introduce a fourth category of monitoring should there be a need to investigate and resolve a specific impact.

2.4.2. Timing

In order to ensure that the immediate effects of the WEF on resident and passing birds are recorded, before they have time to adjust or habituate to the development, post-construction monitoring should start on, or soon after the Commercial Operation Date. If there is a particularly high risk of collision associated with any of the turbines during commissioning and testing the designated avifaunal specialist may advise that monitoring should begin sooner.

While monitoring immediate effects is valuable, it is equally important to obtain an understanding of the impacts of the WEF as they are manifest over the lifespan of the facility. Over time, the habitat within the WEF and the composition and behaviour of the avifauna within it can be expected to change. Consideration must therefore be given to how impacts might vary over the lifespan of the facility and it may be necessary to repeat certain aspects of monitoring at different time intervals.

2.4.3. Duration and scope

The duration of post-construction monitoring should be determined by the sensitivity of the environment and the potential risk to birds. The avifaunal specialist report should provide a preliminary indication of the likely duration and scope of post-construction monitoring, but this should be reconsidered at the end of each year of post-construction monitoring. Extended monitoring will permit short-term and long-term effects to be distinguished.

As a minimum, survey protocols used in the pre-construction monitoring should be repeated during the first two years of operation and should be combined with monitoring of fatalities. The need for further monitoring of bird abundance and movements should be reviewed at the end this period to determine if it is necessary to continue with some, or all, components of this work. The need for further monitoring of fatalities shold also be reviewed after the first two years, and then again on an annual basis. Carcass searches must, however, be repeated in the fifth year, and again every five years thereafter at all facilities.

Although post-construction monitoring is unavoidably onerous, there may be substantial benefits to maximising the duration and frequency of post-construction monitoring (or parts thereof). There is evidence that the abundance of birds at wind farms changes over time and short-term studies may not provide a true indication of the impacts over the lifespan of the facility (Stewart, Pullin, and Coles 2007). Studies in North America also point to high inter-annual variation in fatality rates for raptors; relying on a single year's monitoring can lead to estimates that are not representative of actual fatality rates (Smallwood, 2013). Where collision rates are low (e.g. less than one bird per annum), it may take years before a casualty is recorded, yet even low collision rates can be significant for some species (Scottish Natural Heritage, 2009).

Where there is a low confidence in the findings of the impact assessment, adaptive management is commonly relied on as a mitigation measure. Adaptive management can be an important tool should there be unanticipated negative impacts. By its nature, adaptive management necessitates a significant commitment to post-construction monitoring.

The duration of post-construction monitoring (or parts thereof) should be extended where:

i. significant inter-annual variation in the presence of some species is expected (e.g. wet and dry periods in arid areas),
ii. there is likely to be inter-annual variation in crops,
iii. where the data point to significant operational-phase impacts,
iv. there is a need to distinguish between impacts relating to construction and impacts of a more permanent nature, and/or
v. additional monitoring may help point to appropriate mitigation measures.

As the site-specific issues at each WEF become apparent over time, the scope of post-construction monitoring can be tailored to address the primary impacts of concern.

2.4.4. Habitat classification

Any observed changes in bird numbers and movements at a WEF could be linked to changes in the available habitat (as well as changes in weather conditions, rainfall, etc.). The avian habitats available on both the project and reference sites should therefore be mapped at least once a year (at the same time every year), using the same methodology used in the reconnaissance/scoping phase of monitoring.

2.4.5. Bird abundance and movements

In order to determine if there are any impacts relating to displacement, disturbance, habitat change, changes in mortality rates, changes in breeding success, etc., all methods used to estimate bird abundance and movements during pre-construction monitoring should be applied in exactly the same way (and under similar environmental conditions) in the post-construction phase in order to ensure the comparability of these two data sets. This includes sample counts of small terrestrial species, counts of large terrestrial species and raptors, focal site surveys and vantage point surveys. To minimise the impacts of observer bias, the same observers should ideally be used for pre- and post-construction.

If pre-construction monitoring included areas no longer considered for development, the broader impact zone can be redefined and the extent of post-construction monitoring may be reduced.

There may be instances where replicating pre-construction monitoring exactly is not possible or desirable (for example where pre-construction monitoring did not follow Best Practice, did not focus adequately on key issues, and/or certain areas are no longer accessible or comparable). The specialist may adjust and enhance the survey protocols if this will help meet the objectives of monitoring.

2.4.6. Fatality estimates

The primary aims of monitoring fatalities are to meet four key objectives as identified below.

a) Estimate the number and rate of fatalities at a WEF.
b) Describe the species composition of fatalities (as well as the age and sex where possible).
c) Record and document the circumstances and site characteristics surrounding avian fatalities at turbines and ancillary infrastructure of the WEF (this could aid understanding the cause of fatalities, and hence possible mitigation).
d) Mitigate impacts by informing final operational planning and on-going management.

There are normally three separate components to estimating fatalities:

a) experimental assessment of search efficiency and scavenging rates of bird carcasses on the site;
b) regular searches for collision casualties (Morrison, 2002; Barrios & Rodríguez, 2004; Krijgsveld et al., 2009); and
c) estimating fatality rates based on these data (Smallwood, 2007, 2013; Bernardino et al., 2013).

(a) Searcher efficiency and scavenger removal

The value of surveying the area for collision victims only holds if some measure of the accuracy of the survey method is developed (Morrison, 2002; Bernardino et al., 2013). The search area, the probability of a carcass being detected, and the rate of removal/decay of the carcass must be accounted for when estimating collision rates and when designing the monitoring protocol (Korner-Nievergelt et al., 2011; Strickland et al., 2011; Bernardino et al., 2013).

Scavenging rates, carcass persistence and searcher efficiency may differ for different sizes of birds (and for bats). It may therefore be necessary to use separate estimates for small, medium and large birds (Strickland et al., 2011).

Searcher efficiency and scavenger removal trails should be repeated at least twice a year (i.e. once in summer and once in winter) to account for different conditions.

(i) Searcher efficiency

In order to estimate the probability of an observer detecting a carcass, a sample of suitable bird carcasses should be obtained and distributed randomly around the search area. The number and location of the paced carcasses should be recorded and these carcasses should be of similar size and colour to the priority species. The proportion of the carcasses located in surveys will indicate the relative efficiency of the survey method (Morrison, 2002; Barrios & Rodríguez, 2004; Krijgsveld et al., 2009). These trials should be done under the supervision of the avian specialist during the scheduled carcass searches, without the knowledge of the field teams. Separate trials should be conducted for each individual searcher or search team.

The location of all carcasses not detected by the survey team should be checked subsequently to discriminate between error due to search efficiency (those carcasses still in place which were missed) and scavenge rate (those immediately removed from the area).

(ii) Scavenger removal

In order to determine the rates at which carcasses are scavenged, or decay to the point that they are no longer obvious to the field workers, fresh carcasses of bird of similar size and colour to a variety of the priority species should be placed randomly around the search area and the location of each carcass recorded. As far as possible, carcasses used in trials should mimic the species characteristics and state of carcasses from wind-turbine collisions (Smallwood, 2013). However, it is acknowledged that obtaining suitable material may be challenging. Care should be taken to avoid tainting carcasses with human scent (Whelan et al., 1994) and the total number of carcasses set out should not be less than 20, but not so plentiful as to saturate the food-supply for the local scavengers (Smallwood, 2007).

These sites should be checked daily for the first week to record any changes in the presence, location and condition of each carcass. After the first week, the search interval can be increased and searches should continue for up to a month (Gove et al., 2013). This should provide an indication of scavenge rate (average persistence time) that should inform subsequent survey work for collision victims, particularly in terms of the frequency of surveys required to maximise survey efficiency and/or the extent to which estimates of collision frequency should be adjusted to account for scavenge rate (Osborn et al., 2000; Morrison, 2002; Strickland et al., 2011). There are different models to predict the probability of a carcass persisting over time (see Bispo et al., 2012) and the approach used should be clearly defined. Scavenger numbers and activity in the area may also vary seasonally (Smallwood, 2007). Scavenge and decomposition rates should therefore be measured at least twice over a monitoring year, once in winter and once in summer. Scavenger removal rates may also differ according to ground-cover (Á. Camiña, pers. comm.); it may be necessary to stratify surveys to account for this.

(iii) Integrated detection trials

An alternative approach could be to conduct integrated detection trials, where trial carcasses of a suitable range of birds are placed on random days each week, at random locations within the search areas. Trial carcasses and fatalities caused by wind turbines should be carefully recorded, but left in place and monitored. Carcasses detection rates (ideally related to body mass) can then be calculated at the end of the study (Smallwood et al., 2015).

(b) Carcass searches

(i) Search effort

The accuracy of estimates of fatality rates is influenced by survey effort. If only a small proportion of turbines within a WEF are surveyed, there is a risk that the set of turbines sampled are not representative of the entire wind farm. If monitoring is only conducted over a short timespan, key events may be missed (Peron et al., 2013). If only a small area beneath each turbines is surveyed, some carcasses may fall outside the search area and may not be detected (Smallwood, 2013). While there are practical and cost implications of increasing search effort, this must be weighed against the risks of introducing various sources of bias. Maximising search effort (e.g. by increasing the frequency and duration of surveys, and the proportion of turbines surveyed) will reduce the risk of inaccurate results.

The developer, specialist and landowner may need to negotiate the timing and extent of surveys in croplands. Monitoring will require access to the wind farm and a substantial area beneath the turbines, which may interfere with farming operations. This should be clearly dealt with in lease agreements so monitoring is not compromised.

(ii) Search area

The area below each of the turbines should be checked regularly for bird casualties. Turbine characteristics (e.g. rotor length) may affect the area in over which carcasses fall (Anderson et al., 1999; Morrison, 2002; de Lucas et al., 2008; Smallwood & Thelander, 2008). Some studies have attempted to determine the ideal search area (e.g. Hull & Muir 2010), but these recommendations are often tempered by financial and practical constraints (Bernardino et al., 2013).

As a minimum, the radius of the search area should be equal to 75% of the turbine height (ground to vertical blade-tip). In many early studies, a search radius of 50-60 m was used (Smallwood & Thelander, 2008; Bernardino et al., 2013); an area similar to that recommended in the equivalent guidelines for bats in South Africa (which recommends a radius of at least half the distance from the maximum blade tip height to the ground) (Aronson et al., 2014). While adequate for bats, this area has been found to be insufficient to accurately assess bird mortalities (Smallwood, 2013). More recent guidelines (e.g. Strickland et al. 2011) recommend a search radius equal to 100% of the maximum distance between the ground and the tip of the blade. The recommended 75% of the turbine height represents a compromise between these two approaches. A proportion of carcasses are likely to fall outside of the recommended search area and avian fatality rates can therefore be expected to be underestimated (Smallwood, 2013).

The size of the search area should remain the same throughout the study. The area around each turbine should be searched using transects located no more than 10 m apart; this width should be reduced where thick groundcover hampers visibility. Transects should be walked slowly, and the target area searched carefully and methodically for any sign of a bird-collision incident (carcasses, dismembered body parts, scattered feathers, injured birds).

It may be acceptable to search only a subset of the search area if the habitat is such that surveying the entire area is not possible (e.g. steep slope, thick, shrubby vegetation, tall crops), although such circumstances should be carefully documented.

Where visibility (ground cover) within the search plot is highly variable these areas should be mapped and assigned visibility classes to control for varying probabilities of detection (Strickland et al., 2011; Smallwood, 2013). The groundcover and terrain will influence the time spent searching each turbine.

In tandem with surveys of the wind farm, all guyed masts and sample sections of any new lengths of power line associated with the development should also be surveyed for collision and/or electrocution victims using established protocols (Anderson, 2001; Shaw, Jenkins, Ryan, et al., 2010; Shaw, Jenkins, Smallie, et al., 2010).

(iii) Search interval

The period between searching individual turbines, the 'search interval', should be informed by assessments of scavenge and decomposition rates conducted in the initial stages of the monitoring period. As a rule of thumb, a search interval of two weeks could be expected, although this may vary according to the objectives of the study and environmental conditions at the WEF.

Strickland et al. (2011) suggested that the search interval should ideally be shorter than the average carcass removal time. However scavenger trials in the Karoo indicated that large bird carcasses either were removed within a few days (although feathers may remain for longer), or persisted for a long time (Schutgens, Shaw & Ryan, 2014). There may therefore be limited value in sampling every two weeks versus every month. It is unclear if a similar pattern can be expected for small birds or for different environments. Further information in this regard relevant to South African conditions is required.

The primary objective of fatality searches also should influence the search interval. For example, carcass-removal rates are likely to be low and searcher efficiency high for large-bodied raptors. If these birds are of primary concern, longer search intervals (up to 30 days) may be acceptable. However, this may compromise fatality estimates for smaller birds (Strickland et al., 2011) and would not be appropriate where there is a potential risk of collisions for small species of conservation concern. Bearing this in mind, it may be necessary to have two complementary approaches to sampling, and two different search intervals: 1) intensive, regular sampling of a subset of turbines and 2) extensive, less frequent sampling for large-bodied bird carcasses. While this approach is not ideal for determining average fatality rates (Smallwood, 2013), it does represent a compromise where significant mortalities of large birds at a particular turbine, or group of turbines, can be identified with limited resources.

(iv) Which turbines should be searched?

It is recommended that all turbines at each wind farm are surveyed, if necessary using the two different survey methods (intervals) as described above. This approach will help ensure impacts on priority species are recorded as collision rates vary greatly between wind farms and between turbines (Drewitt & Langston, 2008) and collision rates are also not well correlated with anticipated risk (Ferrer et al., 2012).

No fewer than 30% or 20 turbines (whichever is greater) at any single WEF should be surveyed using the more rigorous (intensive) sampling methods. These turbines should be selected randomly, or through stratified random sampling where habitat variation is pronounced. Most estimators of fatalities assume that the same turbines are searched at regular intervals; once the subset of turbines has been selected, these should be fixed for the rest of the monitoring period, unless there is good reason to change this.

(v) Combining bat and bird carcass searches

In most instances carcass surveys will be required for both birds and bats. There is no clear reason for not combining the two searches into a single effort, although there are some inherent challenges to aligning the survey protocols for these two groups. Bird carcasses typically may be found further away from turbines than those of bats (Strickland et al., 2011; Smallwood, 2013), so birds require a larger search area. Conversely, bats are normally small and their carcasses may not persist for long in a detectable state. Bats are also less likely to leave evidence of a fatality compared to birds the feather puffs of which may provide an indication of a collision. Bats therefore call for particularly frequent and intensive searches (Smallwood, 2013). There has already been an attempt to integrate the protocols (e.g. by minimising the recommended search area for birds), but it is recognised that a flexible approach is required to do this adequately. Search protocols should be designed with input from both bird and bat specialists, who would need to agree on the priorities for each particular site. Where survey protocols favour bats and small birds, this must be supplemented with less intensive, less frequent surveys of the remaining turbines to maximise the chances of recording fatalities of scarce large-bodied priority species, the carcasses of which are likely to be more visible and persist for longer than those of bats (see iii above).

RECORDING AND REPORTING MORTALITIES:
All suspected collision incidents should be comprehensively documented, detailing the following recommended variables:

- Observer name
- Project name
- Date
- Time
- Species
- Age class (where possible)
- Sex (where possible)
- GPS location/s
- Condition of remains
- Nearest turbine number
- Distance to nearest turbine
- Compass bearing to nearest turbine
- Habitat type/mix of habitats
- Gradient of slope (flat, gentle, steep)
- Aspect of slope (none, north, north-east, east…)
- Plot on map
- Photograph the collision site as it was located

(vi) Carcass management

All physical evidence associated with located carcasses should be photographed, referenced (including accurately geo-referenced using a GPS), checked for age and sex (where possible). Carcasses should be collected, bagged and carefully labelled (label inside and outside the bag(s) - if double-bagged, put one label inside the outer bag), and refrigerated or frozen to await further examination and possible post-mortem (not applicable where integrated carcass detection trails are underway, see section 2.4.6.(a)(iii)). Where there is any doubt with regards to species affected, an expert should be consulted to verify the identification. Handling of carcasses should be limited, particularly if these are to be used in scavenger-removal trials.

The landowner's permission must be obtained to collect, store and transport carcasses. The provincial conservation authority should also be consulted to confirm which, if any, permits are required to keep and transport carcasses. They should also be consulted to help determine what should ultimately happen to the carcasses (e.g. if they should be used in searcher-efficiency/scavenger-removal trials, or lodged with a museum, or otherwise disposed of).

If an injured bird is recovered, it should be contained in a suitably sized cardboard box. The local conservation authority should be notified that the bird will be transported to the nearest veterinary clinic or wild-animal/bird rehabilitation centre. In such cases, the immediate area of the recovery should be searched for evidence of impact with the turbine blades, and any such evidence should be fully documented (as above), including outcome and possible post-mortem.

(vii) Ad hoc recording of collisions

Maintenance staff should be required to report bird mortalities through a formalised reporting system throughout the lifespan of the facility. This should be additional to post-construction monitoring and does not replace formal carcass searches. All information outlined in the box above (particularly the GPS position) should be recorded as far as possible.

Where there are incidental carcass finds at turbines that are being formally monitored they should be left in place where they may be detected during formal searches (Smallwood, 2013).

Details of incidental carcass finds should be included in post-construction monitoring reports. Where bird carcasses are found in years where there is no formal monitoring, carcasses should be labelled, bagged and frozen. Fatalities should be reported annually to BirdLife South Africa, EWT and the Department of Environmental Affairs/SANBI (more often if significant incidents occur).

(viii) Alternative survey methods

Trained dogs can be used to assist in the detection of collision carcases (Bevanger et al., 2010; Paula et al., 2011) and could be considered as an alternative search method. Dogs can increase searcher efficiency, reduce observer bias and reduce the amount of time required to search (Paula et al., 2011). This technique may be particularly useful where visibility is poor due to vegetation cover (e.g. in croplands), but does require significant levels of skill on the part of handlers and dogs, and training must be on-going. The use of dogs for carcass searches is encouraged as this can help reduce margins of error when estimating fatality rates.

A variety of remote devices have also been developed to aid the detection of collision incidents, although many of these were designed with offshore environments in mind (for further details see Collier et al. 2011). These devices may be useful as a trigger for additional carcass searches, but should not replace the above protocols until their effectiveness has been tested.

Cameras mounted on mobile devices such as drones may also assist with carcass detection. Once again, until their efficacy has been proven, these tools should supplement, not replace standard survey protocols.

(c) Fatality estimators

Observed mortality rates need to be adjusted to account for searcher efficiency, scavenger removal and the probability that some carcasses may be outside the search area (Korner-Nievergelt et al., 2011; Strickland et al., 2011; Bernardino et al., 2013). There have been many different formulas proposed to estimate mortality rates (e.g. Erickson et al. 2004; Smallwood 2007; Korner-Nievergelt et al. 2011; Smallwood 2013; Péron et al. 2013). Strickland et al. (2011) and Bernardino et al. (2013) provide a good overview of the different estimators. It is recommended that more than one formula be considered for use, depending on their applicability to each circumstance (Bernardino et al., 2013). There are tools available to assist with fatality estimates, e.g. http://www.wildlifefatalityestimator.com and fatality CMR (Péron & Hines 2013).

2.4.7. Reporting

Quarterly interim monitoring reports should be completed for each site, summarising the results of that previous three months monitoring. A post-construction monitoring report, analysing these results, should be completed at the end of each year of monitoring.

As a minimum, the annual report should attempt to answer the questions listed below.

a) Has the habitat available to birds in and around the WEF changed?
b) Has the abundance of birds and/or species composition changed?
c) Have the distributions and/or movements of priority species changed?
d) Is there evidence that the breeding success at focal nest sites may have changed?
e) Where the answer is yes to any of the above four questions, what is the nature of the observed changes? (Compare these changes before (during) and after construction).
f) What is the nature, and likely drivers, of any changes observed?
g) What is the likely demographic and ecological significance of any observed changes in bird populations at the site (including consideration of the magnitude and direction of change) at both the local and broader population scale?
h) What are the collision rates and total number of bird fatalities at the WEF? (Collision rates should be reported per MW (nameplate capacity) and per turbine. Data should be reported in both raw and corrected forms).
i) What is the species and, as far as possible, age and sex composition of fatalities?
j) What proportion of fatalities is likely to be due to collisions with wind turbines?
k) Are there any factors (e.g. site characteristics and proximity to wind turbines) that may contribute to these fatalities?
l) Is additional monitoring and/or mitigation necessary and if so, what needs to be done?

The post-construction monitoring report should include a comparison of the predicted and observed impacts, as this may provide useful insights for future impact assessments. If additional mitigation was implemented on the basis of previous post-construction monitoring, the report should include an assessment of the effectiveness of these measures. The need for further post-construction monitoring and the scope of any further work should also be reviewed.

The findings and recommendations of the post-construction monitoring report should be included in the updated Environmental Management Programme. Should significant impacts be observed, mitigation and/or compensation options should be discussed with the developer, the Department of Environmental Affairs, BirdLife South Africa, EWT, and other relevant stakeholders.

3. Implementation

KEY POINTS

- These guidelines are aimed at all WEFs that require environmental authorisation for electricity generation. They were not intended for small wind turbines or small wind farms (although a specialist input will be required for both).
- The scope of monitoring required will vary from site to site; these guidelines set out the minimum effort that is likely to be required. Any deviation from the minimum, or enhanced protocols, should be well motivated and clearly justified.
- A bird specialist must oversee the monitoring and hire capable and competent field staff.
- Pre-construction monitoring is a critical component of avifaunal impact assessment and must be included in the EIA.
- Peer review of monitoring reports is encouraged. This should be done transparently and all reports should be made available for review.
- Monitoring data and reports should be made publically available, as this will help support the sustainable development of renewable energy.

3.1. Applicability of these guidelines to small wind farms

The sensitivity of birds to the impacts of wind energy does not appear to be strongly correlated to the size of the WEF, or the number and capacity of turbines (Hötker, Thomsen & Jeromin, 2006; Pearce-Higgins et al., 2012). It is therefore recommended that these guidelines be applied to all WEFs that require environmental authorisation for electricity generation. The extent of monitoring required (for example number of vantage points and transects) would, however, be influenced by the size of the project.

A single poorly placed wind turbine potentially could cause more damage than a large, well-located wind farm. For smaller facilities (fewer turbines), an avifaunal specialist must therefore be consulted to determine the scope of the assessment necessary. In these cases, the level of monitoring required should be dictated by the complexity and sensitivity of the receiving environment (e.g. conservation priority of species potentially affected).

These guidelines were not intended for small wind turbines (i.e. less than 50 kW and/or less than 25 m high). These facilities should also be assessed on a case-by-case basis.

3.2. Monitoring masts and other infrastructure

Prospective developers normally erect a number of guyed lattice wind-monitoring masts around a proposed development area in order to gather wind data for the project. An avifaunal specialist should be consulted before the installation of these masts, particularly with regards to the need to attach markers to the guy wires in order to reduce collision risk for birds. In the event that guy wires of existing guyed masts have not been marked, the specialist should provide input in scoping reports on the need to do so retrospectively. From the onset of pre-construction monitoring until the completion of post-construction monitoring, all such masts should be checked for collision mortalities during each site visit.

While the more general development impacts (for example construction of roads, sub-stations and power lines, etc.) associated with the actual construction of each WEF are not a primary focus of this document, these may be severe. The scale and mitigation of these impacts should be referred to explicitly in scoping level and avifaunal specialist reports should be integral to the ultimate decision to proceed with the project.

3.3. Survey effort

Each project should broadly comply with the guidelines provided here, although the scale of each project, the level of detail and technical input, and the relative emphasis on each survey and monitoring component, will vary from site to site in terms of the risk potential identified by the initial scoping or environmental impact assessment (EIA) studies. In principle, each investigation should be as inclusive and extensive (both spatially and temporally) as possible, but be kept within reasonable cost constraints, consistent with the anticipated conservation significance of the site and its avifauna. Time, human capacity and finances are all legitimate constraints on the extent and intensity of monitoring work possible, but cannot at any stage be allowed to override the need to maintain the levels of coverage required to thoroughly evaluate the sustainability of a proposed WEF.

In general, the detail and rigour required in any given monitoring project will be proportional to the size of the proposed WEF (number of turbines and spatial extent), topographic and/or habitat heterogeneity on site, the relative importance of the local avifauna (in terms of diversity, abundance and threat status) and their habitats (e.g. wetlands and flyways), and the anticipated susceptibility of these birds to the potential negative impacts of a wind-energy development. These guidelines set out the minimum effort that is likely to be required in most instances. Any deviations from this minimum should be carefully considered, well motivated and clearly justified.

Monitoring effort should be intensified if there are factors that add substantially to the potential impact of a development, e.g. high densities or diversity of threatened and/or endemic species, or the close proximity of known and important avian flyways or wetlands.

3.4. Specialists and field teams

The bulk of the work outlined in these guidelines should be done by trained observers, under the guidance and supervision of a qualified and experienced specialist ornithologist. A list of avifaunal specialists who have agreed to follow these guidelines is available at www.birdlife.org.za and www.ewt.org.za. Alternatively please email energy@birdlife.org.za.

The specialist and their team must be independent (i.e. have no business, financial, personal or other interest in the WEF, other than fair remuneration for work performed in connection with that activity or application).

The Natural Scientific Professions Act of 2003 provides for the establishment of the South African Council of Natural Scientific Professions (SACNASP) and for the registration of professional, candidate and certified natural scientists. This Act states that only a registered person may practice in a consulting capacity. The specialist ornithologist should therefore be registered with SACNASP.

While field staff need not be registered with a professional body, it is the specialist’s responsibility to ensure that the team has the necessary skills (for example bird identification and map reading) to undertake the required work. An avifaunal specialist familiar with the site should always oversee monitoring.

Ideally, field workers should operate in pairs on the assumption that two people working together are likely to see and record more, and maintain higher health and safety standards, than one person working alone, but without the significant additional costs that may be incurred by the deployment of larger teams. On occasion, it may be possible for experienced observers to effectively survey alone.

The field team undertaking carcass searches do not need the same skills as the team monitoring bird populations and movements (although some training is likely to be required).

Specialists are encouraged to provide the field staff an opportunity to study the monitoring reports. This will help ensure no valuable observations are missed, as field staff will be most familiar with the site.

The role of the developer and the operational staff at the WEF should not be underestimated. Specialists are encouraged to help the developer and their staff gain a clear understanding of the conservation issues on site, and developers are encouraged to familiarise themselves with these guidelines and specialists' reports.

3.5. Equipment

Field teams will require specialized equipment in order to gather monitoring data accurately, quickly and efficiently. In many cases, especially before the WEF is operational, an off-road vehicle (ideally a 4x4) will be required to make maximum use of the available road infrastructure on site. Each team member will need a pair of good quality binoculars and a recent regional bird identification guide. A spotting scope may prove useful and a GPS, a digital camera and a means to capture data – a notebook, datasheets, or generic or customized PDA – are essential equipment. Electronic data capture devices, digital video cameras, hand-held weather stations and laser range-finders are useful, optional extras, that will facilitate the rapid acquisition, collation and processing of the maximum amount of relevant and accurate information on each survey.

Each field team should have at least one set of hard-copy maps (at a minimum scale of 1:50 000) covering the full study area for accurate navigation and plotting of sightings. Digital maps of the area, on which sightings can be plotted directly in digital format, are useful, optional extras, which should facilitate the accurate capture of spatially explicit information. The importance of accurately and clearly recording data cannot be overemphasised. The text boxes throughout this document should provide the basis for standard recording forms for each project.

3.6. The EIA process and best practice

The stages outlined in these guidelines should be aligned with the similarly named stages of a formal EIA process, although a more proactive approach is also encouraged. For example, the scoping stage as outlined in these guidelines should coincide with, and serve as, the scoping study for the purposes of EIA. However, it may prove to be valuable for developers to commission an avifaunal scoping study as part of their project screening, prior to initiating a formal impact assessment process, as this might help avoid unnecessary investment in unsuitable sites. However, the full scoping report should always include the avifaunal scoping report to afford stakeholders an opportunity to provide comment at an early stage. Similarly, there may be value in starting pre-construction monitoring prior to beginning the formal EIA process. However, the results of both scoping and pre-construction monitoring should substantially inform the avian impact assessment report, and be the basis upon which the decision whether of not an environmental authorisation should be issued. Pre-construction monitoring must therefore be completed before the impact assessment is finalised (although, as indicated above, further pre-construction monitoring may be required if there is a prolonged period of time between the granting of environmental authorisation and the commencement of construction).

It is the responsibility of both the environmental assessment practitioner and the avifaunal specialist to ensure that the specialist's work is reflected appropriately in the Scoping and Environmental Impact Assessment reports. This should be reflected in the relevant contracts. It is recommended that avifaunal specialists be sent material distributed to registered interested and affected parties, so that they can be kept abreast of the progress of proposed developments in which they have been involved.

3.7. Peer review

Peer review is the evaluation of a specialist's work by another expert (or experts) in the field in order to maintain or enhance the quality of work. Peer review can be a valuable tool in avifaunal specialist reporting as it can help to maintain standards and increase consistency of recommendations across projects. It can also help to improve and strengthen the end product and add credibility to the process.

The use of professional peer review for renewable energy applications therefore is encouraged, subject to the five points listed below.

i. The original author should be advised that a peer review will be conducted.
ii. Ideally, the original author should be requested to provide a list of potential candidates to conduct the review, but the final choice of reviewers should lie with the relevant environmental assessment practitioner under whose supervision the specialist is operating.
iii. The 'reviewer' must be given clear terms of reference, explaining the context of the review.
iv. The results of the peer review must be made available to the original author for right of response.
v. The reviewer must complete and submit his/her own declaration of interest with the application to DEA.
vi. Both the original report and the peer review report should be made available for public review and decision-making.

3.8. Data management and data sharing

Monitoring reports and supporting data should be made publically available and shared with BirdLife South Africa, EWT, provincial authorities, Department of Environmental Affairs, the South African National Biodiversity Institute and any other relevant body (e.g. a national database, when this is established). While analysis and reporting at individual WEFs will be the responsibility of the relevant avifaunal specialist, reports and data emanating from the above process should ultimately be housed centrally to facilitate the assessment of results on a multiple WEF, landscape and national scale. Permission to publish the findings of such analyses in the relevant media by EWT/BirdLife South

Africa, BARESG, or by accredited academic institutions should be obtained from the developer before the onset of monitoring. This pooling of information is in the interests of collective understanding and building a sustainable renewable-energy industry in southern Africa.

Specialists are also encouraged to submit findings (whether positive, negative or inconclusive) to peer-reviewed scientific journals to promote wider dissemination of results and experience. Among other things, this will help improve study design and knowledge of possible impacts. Developers are encouraged to give permission to use data from their facilities for this purpose.

SABAP1 and 2 data are utilised extensively in the scoping and impact assessment processes for WEFs. Specialists are therefore encouraged to register with the SABAP2 project and contribute to this project. This can be done by either submitting incidental records or, preferably, full protocol atlas cards completed for all the pentads (5 x 5 minute squares) making up each development site. These cards should be submitted on every survey (including those made during pre-construction and post-construction monitoring). If necessary, this can be done as a completely separate contribution to ornithology, generated as a by-product of monitoring, rather than as a direct component of the data collected for the client. For more information on SABAP2 please refer to http://sabap2.adu.org.za.

Where birds have been fitted with tracking devices, specialists are encouraged to submit their data to www.movebank.org.

Any carcasses found beneath power lines should be reported to the Eskom / EWT Incident Reporting Hotline (0860 111 535, email wep@ewt.org.za)

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APPENDICES

1. A step-wise approach to impact assessment and bird monitoring at a proposed wind-energy site

The following are key steps in the successful design and implementation of bird monitoring at a proposed wind-energy development site:

1. A qualified advising scientist, and a capable monitoring agency, are appointed to conduct pre-construction monitoring/impact assessment (and preferably post-construction phase monitoring).
2. A scoping study is undertaken, based on a short site visit and desktop information.
3. Monitoring protocols are established and agreed to. Generic guidelines are customised to suit the specific issues at each site. Proposed protocols are discussed with key stakeholders (e.g. BirdLife South Africa and Endangered Wildlife Trust), particularly if consideration is being given to undertaking less than the minimum outlined in these guidelines.
    a. Consideration is given to using technology for monitoring bird movements (e.g. radar or transmitters). If the use of technology is warranted, the budget must be secured and hardware, software, relevant expertise, permits and ethical clearance must all be obtained (where applicable).
4. Pre-construction monitoring begins.
    a. Pre-construction monitoring data are periodically collated and analysed to permit necessary changes to be made at the earliest opportunity. Data-collection protocols and schedules are adapted to ensure that sufficient data are accumulated, and sufficient coverage is achieved, to adequately inform development decisions. The use of transmitters and radar is reconsidered, if not already in use.
    b. There is regular communication between the specialist, developer and other consultants, particularly if there are any potentially significant issues encountered. Where there are potentially significant issues, stakeholders (e.g. BirdLife South Africa and Endangered Wildlife Trust) should also be consulted.
5. A report reviewing the full year of pre-construction monitoring is compiled and the findings integrated into the EIA and Environmental Management Programme (EMPr) for the project. Protocols for construction-phase monitoring (where required) and for post-construction monitoring are outlined.
6. The final EIA is submitted to the Department of Environment for environmental authorisation.

For those projects for which environmental authorisation is granted and construction proceeds:

7. The need for further pre-construction monitoring is assessed, particularly if considerable time elapses between collection of data for impact assessment and the commencement of construction.
8. The EMPr is applied during construction and, if necessary, construction-phase monitoring is conducted.
9. The post-construction monitoring protocols are refined and post-construction monitoring is initiated as soon as the wind turbines are operational.
    a. Post-construction monitoring data are periodically analysed and, if necessary, data-collection protocols are adjusted to ensure that sufficient data are accumulated and sufficient coverage is achieved to adequately inform operational decisions.

10. A report reviewing the full year of post-construction monitoring is compiled and submitted to the relevant authorities and stakeholders. The findings of monitoring are integrated into the EMPr for the operating wind farm and the broader mitigation scheme. The need for, and scope of, further post-construction monitoring is reviewed.

2. Minimum requirements for avifaunal impact assessment

An avifaunal impact assessment for a WEF should follow a two-tier process:

1) Scoping – a review of existing literature and data, as well as a site visit to inform the design of a site-specific survey and pre-construction monitoring plan.
2) Impact assessment – systematic and quantified monitoring over four seasons that will inform a full Environmental Impact Assessment (EIA) detailing and analysing the significance of likely impacts and available mitigation options.

1) Scoping

The scoping assessment should be based on a review of existing literature and bird-atlas data, the BirdLife South Africa and Endangered Wildlife Trust Avifaunal Wind Farm Sensitivity Map, distance from protected areas and recognized Important Bird and Biodiversity Areas, as well as avifaunal data collected during a brief site visit to the proposed wind-farm site. The Scoping Report should contain the information listed below.

a. A description of the site in terms of the avifaunal habitats present.
b. A list of bird species likely to occur on the proposed site, with information on the relative value (in terms of breeding, nesting, roosting and foraging) of the site for these birds with a particular focus on priority bird species.
c. A description of the likely seasonal variation in the presence/absence of priority species and preliminary observations of their movements.
d. A preliminary delineation of areas that are potentially highly sensitive, no-go areas that may need to be avoided by the development.
e. A preliminary description of the nature of the impacts that the proposed development may have on the bird species present.
f. A description of any mitigation measures that may be required to manage impacts related to the monitoring and assessment of the site.

The results of the scoping study, particularly information regarding the diversity and abundance of priority species that are likely to be present, proximity to important flyways, wetlands or other focal sites, and topographic complexity, should be used to:

a. highlight if there are any obvious red flags to the proposed development on all or parts of the site; and
b. inform the required scope, effort, intensity and design of the pre-construction monitoring and impact assessment.

2) Impact assessment

The avifaunal impact assessment should be based on data collected from detailed site surveys, undertaken in accordance with the *BirdLife South Africa/Endangered Wildlife Trust best-practice guidelines for avian monitoring and impact mitigation at proposed wind-energy development sites in southern Africa*. Site surveys must be of sufficient frequency to adequately sample all major variations in environmental conditions/habitat types, with no fewer than four visits to ensure all four seasons are sampled. The degree of effort during each survey should be informed by the likely sensitivity of the site and the species it contains, as well as the size of the proposed wind farm.

The impact assessment must include (with appropriate mapping and statistical analyses where relevant) consideration of the eight key aspects presented below.

a. A comprehensive list of the bird species recorded (or expected to occur) at the relevant sites (including control sites), including details of local distribution (with spatial mapping where appropriate), confirmed and predicted breeding status (again with spatial mapping where appropriate), gross habitat preferences, seasonality, endemism and Red-data status (both globally and nationally). This information should clearly differentiate between species positively recorded at the site by the specialist team, recorded in the general or specific area by other projects (e.g. SABAP, CWAC, CAR, etc.) and species not yet recorded in the area at all but predicted to occur or possibly occur. This information should also identify and justify priority species.
b. Absolute and relative abundance estimates and measures for small terrestrial birds through linear transect surveys and fixed-point counts, and checklist surveys.
c. Counts, density estimates and abundance indices for large terrestrial birds and raptors, through censuses, road transects and vantage-point monitoring.
d. Flight behaviour of priority species flying in or near the future rotor-swept area and associated risk of collisions.
e. Evidence of breeding at any focal raptor sites.
f. Bird numbers at any focal wetlands and local movements between waterbodies.
g. Full details of any incidental sightings of priority species.
h. Collision mortalities related to any existing guyed lattice masts and existing power lines.

This information should be used to cover six primary requirements as outlined below.

a. Develop a topographical map indicating the area that can be expected to be impacted by the proposed development alternatives and the location of any key habitats and flyways that should not be developed or otherwise transformed.
b. Inform the final turbine layout (or where the layout cannot be finalized within the EIA, the assessment should be used to define any no go areas and areas that should be sufficiently buffered).
c. Assess the significance of the potential impact of the proposed project alternatives and related activities - with and without mitigation - on avifaunal species and communities (with regards to potential disturbance, displacement, habitat loss and mortality through collision), including consideration of the spatial and temporal extent of these impacts.
d. Inform actions that should be taken to avoid or, if avoidance is not feasible, to mitigate negative impacts during the planning, construction and operational phases of the development.
e. Inform the nature and extent of monitoring required during construction and the operational phase.
f. Highlight if the proposed development is fatally flawed and should not be recommended for approval.

The avifaunal impact assessment must include a description of the limitations, assumptions and measures of uncertainty relating to the assessment. Where other proposed facilities are proposed in or near to the development in question, the impact assessment must include consideration of cumulative impacts.

The more general development impacts associated with the actual construction of each WEF are not the primary focus of this document. However, these impacts may be severe and should be included in the scoping and impact assessment. Mitigation measures relating to construction-phase impacts should also be outlined in the environmental authorisation and environmental management programme.

3. Recommended conditions of approval

While each development should be considered on a case-by-case basis, the conditions listed below are likely to be appropriate for most wind-farm developments. These recommendations do not preclude the need for additional site-specific conditions.

1. No-go and buffer areas should be clearly defined in the environmental authorisation and indicated on a topographical map. (Condition)
2. Monitoring must be implemented in accordance with BirdLife South Africa/Endangered Wildlife Trust: best-practice guidelines for avian monitoring and impact mitigation at proposed wind-energy development sites in southern Africa. This includes, but is not limited to, the following four aspects.
    a. Post-construction monitoring should use the same methodology as pre-construction monitoring to ensure comparability of results, but should also include the collection of mortality data. (Condition)
    b. Post-construction monitoring should start on, or soon after the Commercial Operation Date. The duration and scope of post-construction monitoring should be informed by the outcomes of the previous year's monitoring, and should be reviewed annually. Post-construction monitoring of bird abundance and movements should span a minimum of two years. Surveying the WEF for fatalities should also be done for a minimum of two years after construction, and must be repeated again at year five, and every five years thereafter.(Condition)
    c. BirdLife South Africa and any other relevant party identified by DEA should be given the opportunity to review and approve the methodology. (Recommendation)
    d. Avifaunal monitoring reports, as well as the raw monitoring data, should be made publically available and forwarded to the Department of Environmental Affairs, BirdLife South Africa, the Endangered Wildlife Trust, and any other relevant party identified by DEA. Post-construction monitoring reports should be forwarded to relevant parties within two months of the completion of an annual monitoring cycle. Relevant data should be entered into a central repository/database (once this is available). (Condition)
3. The results of post-construction monitoring may highlight the need for additional mitigation measures that may need to be incorporated in the environmental management programme. The applicant should be required to take all feasible and reasonable steps to reduce significant impacts on avifauna. (Condition)
4. If deemed necessary by the avifaunal specialist during the EIA, construction-phase monitoring should be conducted and the results of this should inform any additional mitigation that may be required. (Recommendation)
5. The environmental management programme should be reviewed annually for the first five years of the operational phase of the facility. BirdLife South Africa and EWT (and any other party nominated by DEA) should be given the opportunity to comment on the bird-monitoring specifications every year for as long as post-construction monitoring continues. (Recommendation)

6. If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible (provided this complies with Civil Aviation Authority regulations). (Recommendation)
7. Lighting of the wind farm (for example security lights) should be kept to a minimum. Lights should be directed downwards (provided this complies with Civil Aviation Authority regulations). (Recommendation)
8. Where possible applicants should be encouraged to conduct controlled experiments to test the effectiveness of potential mitigation measures that may increase birds perception of wind turbines and associated infrastructure, and hence reduce bird-collision rates. (Recommendation)
9. Clearing of natural vegetation during construction should be kept to a minimum. (Condition)
10. Sufficient drainage should be provided along access roads to prevent erosion and pollution of adjacent watercourses and wetlands. (Condition)
11. Hunting of birds should be prohibited on site. (Condition)
12. All power lines linking wind turbines to each other and to the internal substation must be buried and should follow access roads. Only power lines linking the WEF to the grid may be above ground. Where new power lines cross rivers, other movement corridors or habitat capable of supporting sensitive species, the power lines should also be buried below ground (where feasible).
13. New above-ground power lines should be fitted with bird flight diverters; as a minimum diverters must be fitted in all high-risk areas (durable static bird flight diverters are preferable to dynamic devices which are prone to failure). Bird flight diverters should be visible to birds at night as waterbirds in particular often undertake nocturnal movements, typically in flocks, which increases the risk of collisions. Only Eskom-approved bird-friendly power line pole structures may be used (Condition)
14. The use of guyed towers (for example for wind monitoring or communication) should be minimised and if necessary steps should be taken to increase the visibility of the guy wires through the use of markers. (Recommendation)
15. Maintenance staff should be encouraged to keep noise and other disturbances to a minimum, where priority species may be affected.
16. Routine maintenance should take place outside the breeding season of priority bird species. (Recommendation or, in some cases condition)
17. Maintenance staff should report bird mortalities through a formalised reporting system. (This should be additional to, not replace, formal carcass searches). (Condition)
18. Land-management practices beneath the towers should not increase the attractiveness of these areas to raptors or other species vulnerable to collisions. Structures should be designed to reduce the availability of perching sites. (Recommendation)

While the applicant may contract individuals or organisations to assist them in undertaking the necessary tasks, it is ultimately the applicant's responsibility to ensure compliance with the conditions of authorisation.

APPENDIX K(H):

TRAFFIC AND TRANSPORATION MANAGEMENT PLAN

PRINCIPLES FOR TRAFFIC AND TRANSPORTATION MANAGEMENT

1. PURPOSE

The purpose of this Traffic and Transportation Management Plan (TTMP) is to address regulatory compliance, traffic management practices, and protection measures to help reduce impacts related to transportation of project components and the construction of temporary and long-term access within the vicinity of the Witberg Wind Energy Facility project site. The objectives of this plan include the following:

» To ensure compliance with all legislation regulating traffic and transportation within South Africa (National, Provincial, Local & associated guidelines).
» To avoid incidents and accidents while vehicles are being driven and while transporting personnel, materials, and equipment to and from the project site.
» To raise greater safety awareness in each driver and to ensure the compliance of all safe driving provisions for all the vehicles.
» To raise awareness to ensure drivers respect and follow traffic regulations.
» To avoid the deterioration of access roads and the pollution that can be created due to noise and emissions produced by equipment, machinery, and vehicles.

Prior to the commencement of construction, a detailed TTMP and Method Statement for the site should be compiled.

2. RELEVANT ASPECTS OF THE PROJECT

Although located in the rural Karoo, the N1 National Road is fairly busy considering Matjiesfontein, which is a National Monument, lies approximately nine kilometres to the northeast of the site. The N1 National Road runs in an east-west direction and transects the northern portion of the site. Direct access to the project site is possible via the N1 onto an existing gravel road that leads to the site. The access road will be 12m in width.

3. TRAFFIC AND TRANSPORTATION MANAGEMENT PRINCIPLES

The following principles apply in terms of transportation and traffic management:

» The Transport Contractor must ensure that all required permits for the transportation of abnormal loads are in place prior to the transportation of equipment and project components to the site. Specific abnormal load routes must be developed with environmental factors taken into consideration.
» Before construction commences, authorised access routes must be clearly marked in the field with signs or flagging. The Construction Contractor must review the location of designated access and will be responsible for ensuring construction travel is limited to designated routes. The entrance of the main access road must not be constructed before a blind rise or on a bend of the public road.
» All employees must attend an environmental training programme (e.g. toolbox talks) by the Environmental Officer (EO). Through this programme, employees will be instructed to use only approved access roads, drive within the delineated road limits, and obey jurisdictional and posted speed limits to minimise potential impacts to the environment and other road users.

- The contractor will be responsible for making sure that their suppliers, vendors, and subcontractors strictly comply with the principles of this TMP and the contractor's TMP.
- Adjacent landowners must be notified of the construction schedule.
- Access roads and entrances to the site should be carefully planned to limit any intrusion on the neighbouring property owners and road users.
- Signs must be posted in the project area to notify landowners and others of the construction activity.
- Flagging must be provided at access points to the site and must be maintained until construction is completed on the site.
- Speed limits must be established prior to commencement of construction and enforced over all construction traffic.
- Speed controls and implementation of appropriate dust suppression measures must be enforced to minimise dust pollution.
- Throughout construction the contractor will be responsible for monitoring the condition of roads used by project traffic and for ensuring that roads are maintained in a condition that is comparable to the condition they were in before the construction began.
- Drivers must have an appropriate valid driver's license and other operation licences required by applicable legislation.
- All vehicles must be maintained in good mechanical, electrical, and electronic condition, including but not limited to the brake systems, steering, tires, windshield wipers, side mirrors and rear view mirror, safety belts, signal indicators, and lenses.
- Any traffic delays attributable to construction traffic must be co-ordinated with the appropriate authorities.
- No deviation from approved transportation routes must be allowed, unless roads are closed for reasons outside the control of the contractor.
- Impacts on local communities must be minimised. Consideration should be given to limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time.

4. MONITORING

- The principal contractor must ensure that all vehicles adhere to the speed limits.
- A speeding register must be kept with details of the offending driver.
- Repeat offenders must be penalised.
- Where traffic signs are not being adhered to, engineering structures must be used to ensure speeds are reduced.

APPENDIX K(I):
STORMWATER MANAGEMENT PLAN

STORMWATER MANAGEMENT PLAN

1. PURPOSE

By taking greater cognisance of natural hydrological patterns and processes it is possible to develop storm water management systems in a manner that reduces these potentially negative impacts and mimic nature. This Storm water Management Plan addresses the management of storm water runoff from the development site and significant impacts relating to resultant impacts such as soil erosion and downstream sedimentation. The main factors influencing the planning of storm water management measures and infrastructure are:

» Topography and slope gradients;
» Placing of infrastructure and infrastructure design;
» Annual average rainfall; and
» Rainfall intensities.

The objective of the plan is therefore to provide measures to address runoff from disturbed portions of the site, such that they:

» do not result in concentrated flows into natural watercourses i.e. provision should be made for temporary or permanent measures that allow for attenuation, control of velocities and capturing of sediment upstream of natural watercourses.
» do not result in any necessity for concrete or other lining of natural watercourses to protect them from concentrated flows off the development if not necessary.
» do not divert flows out of their natural flow pathways, thus depriving downstream watercourses of water.

Prior to the commencement of construction, a detailed Storm water Management Plan for the site should be compiled with the aid of a suitably qualified, professionally registered engineer, following detailed design.

2. RELEVANT ASPECTS OF THE SITE

The proposed Witberg Wind Energy Facility (WEF) is located on a site ~9km west of Matjiesfontein in the Laingsburg Local Municipality, which falls within the jurisdiction of the Central Karoo District Municipality in the Western Cape Province. This development is to be constructed within the project site which comprises the following farm portions:

» Remainder of the Farm Jantjesfontein 164;
» Remainder of the Farm Besten Weg 150;
» Remainder of Portion 1 of the Farm Besten Weg 150;
» Remainder of the Farm Tweedside 151;
» Remainder of the Farm Elandskrag 269; and
» Portion 1 of the Farm Elandskrag 269.

In terms of climate, the Witberg site lies within the Karoo Region, which experiences a semi-arid climate. Winter rainfall occurs between May and August, while the summer months can be very dry. The Karoo is known to experience a number of microclimates and rainfall can vary significantly between areas. Mean annual precipitation is approximately 320 mm, ranging from 15 – 45 mm rainfall per month. The hottest month of the year is typically February (maximum 27.5 °C) while July (minimum 2.2 °C) is typically the coldest month of the year. The predominant wind direction is from the northwest, and frost is normally experienced on 10 - 40 days per year. There exists a microclimate on top of the Witberg ridge. Temperatures are a few degrees colder due to the 300 m to 500 m difference in altitude compared to the valley floors. High wind speeds are common on top of the ridge, notably during winter months. Snowfalls are common during July to August although melt fairly quickly after cold fronts have passed. Average temperatures recorded on site are the highest at 18.4°C in February and lowest in June at 7.0°C.

In the study area, there is at least one small farm dam within the site area and a number of others in the surrounding area. There are no large permanent waterbodies within the site area but topography maps show that there is a large dam close to the northwest boundary of the site, a large pan (Kaal Pan) approximately 10 km south of the site and several smaller pans north of the site (beyond the N1).

The Bobbejaanrivier is located to the northeast of the site and two other perennial rivers are shown on topography maps, to the south and southeast of the site. Due to the topography of the site and the high-ridge it is likely that the site lies within two or more watersheds. There are a number on non-perennial watercourses within the site.

3. STORMWATER MANAGEMENT PRINCIPLES

In the design phase, various storm water management principles should be considered including:

- » Prevent concentration of storm water flow at any point where the ground is susceptible to erosion.
- » Reduce storm water flows as far as possible by the effective use of attenuating devices (such as swales, berms, silt fences). As construction progresses, the storm water control measures are to be monitored and adjusted to ensure complete erosion and pollution control at all times.
- » Silt traps must be used where there is a danger of topsoil or material stockpiles eroding and entering streams and other sensitive areas.
- » Construction of gabions and other stabilisation features on steep slopes may be undertaken to prevent erosion, if deemed necessary.
- » Minimse the area of exposure of bare soils to minimse the erosive forces of wind, water and all forms of traffic.
- » Ensure that development does not increase the rate of storm water flow above that which the natural ground can safely accommodate at any point in the sub-catchments.
- » Ensure that all storm water control works are constructed in a safe and aesthetic manner in keeping with the overall development.
- » Plan and construct storm water management systems to remove contaminants before they pollute surface waters or groundwater resources.
- » Contain soil erosion, whether induced by wind or water forces, by constructing protective works to trap sediment at appropriate locations. This applies particularly during construction.
- » Avoid situations where natural or artificial slopes may become saturated and unstable, both during and after the construction process.

- Design and construct roads to avoid concentration of flow along and off the road. Where flow concentration is unavoidable, measures to incorporate the road into the pre-development storm water flow should not exceed the capacity of the culvert. To assist with the storm water run-off, gravel roads should typically be graded and shaped with a 2-3% crossfall back into the slope, allowing storm water to be channelled in a controlled manner towards the, natural drainage lines and to assist with any sheet flow on the site.
- Design culvert inlet structures to ensure that the capacity of the culvert does not exceed the pre-development storm water flow at that point. Provide detention storage on the road and/or upstream of the storm water culvert.
- Design outlet culvert structures to dissipate flow energy. Any unlined downstream channel must be adequately protected against soil erosion.
- Where the construction of a building causes a change in the vegetative cover of the site that might result in soil erosion, the risk of soil erosion by storm water must be minimised by the provision of appropriate artificial soil stabilisation mechanisms or re-vegetation of the area. Any inlet to a piped system should be fitted with a screen or grating to prevent debris and refuse from entering the storm water system.
- Preferably all drainage channels on site and contained within the larger area of the property (i.e. including buffer zone) should remain in the natural state so that the existing hydrology is not disturbed.

3.1. Engineering Specifications

Detailed engineering specifications for a Storm water Management Plan describing and illustrating the proposed storm water control measures must be prepared by the Civil Engineers during the detailed design phase and should be based on the underlying principles of this Storm water Management Plan. This should include erosion control measures. Requirements for project design include:

- Erosion control measures to be implemented before and during the construction period, including the final storm water control measures (post construction) must be indicated within the Final/Updated Storm water Management Plan.
- All temporary and permanent water management structures or stabilisation methods must be indicated within the Final/Updated Storm water Management Plan.
- The drainage system for the site should be designed to specifications that can adequately deal with a 1:50 year intensity rainfall event or more to ensure sufficient capacity for carrying storm water around and away from infrastructure.
- Procedures for storm water flow through a project site need to take into consideration both normal operating practice and special circumstances. Special circumstances in this case typically include severe rainfall events.
- An on-site Engineer or Environmental Officer is to be responsible for ensuring implementation of the erosion control measures on site during the construction period.
- The EPC Contractor holds ultimate responsibility for remedial action in the event that the approved storm water plan is not correctly or appropriately implemented and damage to the environment is caused.

During the construction phase, the contractor must prepare a Storm water Control Method Statement to ensure that all construction methods adopted on site do not cause, or precipitate soil erosion and shall take adequate steps to ensure that the requirements of the Storm water Management Plan are met before, during and after construction. The designated responsible person on site, must be indicated in the

Storm water Control Method Statement and shall ensure that no construction work takes place before the relevant storm water control measures are in place.

An operation phase Storm water Management Plan should be designed and implemented if not already addressed by the mitigations implemented as part of construction, with a view to preventing the passage of concentrated flows off hardened surfaces and onto natural areas.

APPENDIX K(J):
EMERGENCY PREPAREDNESS, RESPONSE AND FIRE MANAGEMENT PLAN

EMERGENCY PREPAREDNESS, RESPONSE AND FIRE MANAGEMENT PLAN

1. PURPOSE

The purpose of the Emergency Preparedness and Response Plan is:

» To assist contractor personnel to prepare for and respond quickly and safely to emergency incidents, and to establish a state of readiness which will enable prompt and effective responses to possible events.
» To control or limit any effect that an emergency or potential emergency may have on site or on neighbouring areas.
» To facilitate emergency responses and to provide such assistance on the site as is appropriate to the occasion.
» To ensure communication of all vital information as soon as possible.
» To facilitate the reorganisation and reconstruction activities so that normal operations can be resumed.
» To provide for training so that a high level of preparedness can be continually maintained.

This plan outlines response actions for potential incidents of any size. It details response procedures that will minimise potential health and safety hazards, environmental damage, and clean-up efforts. The plan has been prepared to ensure quick access to all the information required in responding to an emergency event. The plan will enable an effective, comprehensive response to prevent injury or damage to the construction personnel, public, and environment during the project. Contractors are expected to comply with all procedures described in this document. A Method Statement should be prepared at the commencement of the construction phase detailing how this plan is to be implemented as well as details of relevant responsible parties for the implementation. The method statement must also reflect the following:

» Identification of areas where accidents and emergency situations may occur;
» Communities and individuals that may be impacted;
» Response procedure;
» Provisions of equipment and resources;
» Designation of responsibilities;
» Communication; and
» Periodic training to ensure effective response to potentially affected communities.

2. PROJECT-SPECIFIC DETAILS

Witberg Wind Power (Pty) Ltd are proposing a Wind Energy Facility (WEF) of up to 80MW capacity. The proposed facility would utilise wind turbines to generate electricity that would be fed into the National Power Grid. The propsed Witberg Wind Energy Facility (WEF) is located on a site ~9km west of Matjiesfontein in the Laingsburg Local Municipality, which falls within the jurisdiction of the Central Karoo District Municipality in the Western Cape Province. This development is to be constructed within the project site which comprises the following farm portions:

» Remainder of the Farm Jantjesfontein 164;

- Remainder of the Farm Besten Weg 150;
- Remainder of Portion 1 of the Farm Besten Weg 150;
- Remainder of the Farm Tweedside 151;
- Remainder of the Farm Elandskrag 269; and
- Portion 1 of the Farm Elandskrag 269.

The Witberg WEF will include the following components:

- 25 wind turbine layout;
- Crane pad area for each wind turbine;
- Substation/s;
- Overhead powerline;
- Underground powerlines;
- Access roads;
- Maintenance and operation buildings;
- Internal road infrastructure; and
- Laydown area and construction camp.

3. EMERGENCY RESPONSE PLAN

There are three levels of emergency as follows:

- Local Emergency: An alert confined to a specific locality.
- Site Emergency: An alert that cannot be localised and which presents danger to other areas within the site boundary or outside the site boundary.
- Evacuation: An alert when all personnel are required to leave the affected area and assemble in a safe location.

If there is any doubt as to whether any hazardous situation constitutes an emergency, then it must be treated as an Evacuation.

Every effort must be made to control, reduce or stop the cause of any emergency provided it is safe to do so. For example, in the event of a fire, isolate the fuel supply and limit the propagation of the fire by cooling the adjacent areas. Then confine and extinguish the fire (where appropriate) making sure that re-ignition cannot occur.

3.1. Emergency Scenario Contingency Planning

3.1.1. Scenario: Spill which would result in the contamination of land, surface or groundwater

i. Spill Prevention Measures

Preventing spills must be the top priority at all operations which have the potential of endangering the environment. The responsibility to effectively prevent and mitigate any scenario lies with the Contractor and the ECO. In order to reduce the risk of spills and associated contamination, the following principles should be considered during construction and operation activities:

- » All equipment refuelling, servicing and maintenance activities should only be undertaken within appropriately sealed/contained or bunded designated areas.
- » All maintenance materials, oils, grease, lubricants, etc. should be stored in a designated area in an appropriate storage container.
- » No refuelling, storage, servicing, or maintenance of equipment should take place within sensitive environmental resources in order to reduce the risk of contamination by spills.
- » No refuelling or servicing should be undertaken without absorbent material or drip pans properly placed to contain spilled fuel.
- » Any fluids drained from the machinery during servicing should be collected in leak-proof containers and taken to an appropriate disposal or recycling facility.
- » If these activities result in damage or accumulation of product on the soil, the contaminated soil must be disposed of as hazardous waste. Under no circumstances shall contaminated soil be added to a spoils pile and transported to a regular disposal site.
- » Chemical toilets used during construction must be regularly cleaned. Chemicals used in toilets are also hazardous to the environment and must be controlled. Portable chemical toilets could overflow if not pumped regularly or they could spill if dropped or overturned during moving. Care and due diligence should be taken at all times.
- » Contact details of emergency services and HazMat Response Contractors are to be clearly displayed on the site. All staff are to be made aware of these details and must be familiar with the procedures for notification in the event of an emergency.

ii. Procedures

The following action plan is proposed in the event of a spill:

1. Spill or release identified.
2. Assess person safety, safety of others and environment.
3. Stop the spill if safely possible.
4. Contain the spill to limit entering surrounding areas.
5. Identify the substance spilled.
6. Quantify the spill (under or over guideline/threshold levels).
7. Notify the Site Manager and emergency response crew and authorities (in the event of major spill).
8. Inform users (and downstream users) of the potential risk.
9. Clean up of the spill using spill kit or by HazMat team.
10. Record of the spill incident on company database.

a) Procedures for containing and controlling the spill (i.e. on land or in water)

Measures can be taken to prepare for quick and effective containment of any potential spills. Each contractor must keep sufficient supplies of spill containment equipment at the construction sites, at all times during and after the construction phase. These should include specialised spill kits or spill containment equipment. Other spill containment measures include using drip pans underneath vehicles and equipment every time refuelling, servicing, or maintenance activities are undertaken.

Specific spill containment methods for land and water contamination are outlined below.

Containment of Spills on Land

Spills on land include spills on rock, gravel, soil and/or vegetation. It is important to note that soil is a natural sorbent, and therefore spills on soil are generally less serious than spills on water as contaminated soil can be more easily recovered. It is important that all measures be undertaken to avoid spills reaching open water bodies located outside of the project site. The following methods could be used:

» *Dykes* - Dykes can be created using soil surrounding a spill on land. These dykes are constructed around the perimeter or down slope of the spilled substance. A dyke needs to be built up to a size that will ensure containment of the maximum quantity of contaminant that may reach it. A plastic tarp can be placed on and at the base of the dyke such that the contaminant can pool up and subsequently be removed with sorbent materials or by pump into barrels or bags. If the spill is migrating very slowly, a dyke may not be necessary and sorbents can be used to soak up contaminants before they migrate away from the source of the spill.

» *Trenches* - Trenches can be dug out to contain spills. Spades, pick axes or a front-end loader can be used depending on the size of the trench required. Spilled substances can then be recovered using a pump or sorbent materials.

b) Procedures for transferring, storing, and managing spill related wastes

Used sorbent materials are to be placed in plastic bags for future disposal. All materials mentioned in this section are to be available in the spill kits. Following clean up, any tools or equipment used must be properly washed and decontaminated, or replaced if this is not possible.

Spilled substances and materials used for containment must be placed into empty waste oil containers and sealed for proper disposal at an approved disposal facility.

c) Procedures for restoring affected areas

Criteria that may be considered include natural biodegradation of oil, replacement of soil and revegetation. Once a spill of reportable size has been contained, the ECO and the relevant Authority must be consulted to confirm that the appropriate clean up levels are met.

3.1.2. Scenario: Fire (and fire water handling)

i. Action Plan

The following action plan is proposed in the event of a fire:

1. Quantify risk.
2. Assess person safety, safety of others and environment.
3. If safe – attempt to extinguish the fire using appropriate equipment.
4. If not safe to extinguish, contain fire.
5. Notify the Site Manager and emergency response crew and authorities.
6. Inform users of the potential risk of fire.
7. Record the incident on the company database or filing register.

ii. Procedures

Because large scale fires may spread very fast it is most advisable that the employee/contractor not put his/her life in danger in the case of an uncontrolled fire.

Portable firefighting equipment must be provided at strategic locations throughout the site, in line with the Building Code of South Africa and the relevant provincial building code. All emergency equipment including portable fire extinguishers, hose reels and hydrants must be maintained and inspected by a qualified contractor in accordance with the relevant legislation and national standards.

Current evacuation signs and diagrams for the building or site that are compliant to relevant state legislation must be provided in a conspicuous position, on each evacuation route. Contact details for the relevant emergency services should be clearly displayed on site and all employees should be aware of procedures to follow in the case of an emergency.

a) Procedures for initial actions

Persons should not fight the fire if any of the following conditions exist:

» They have not been trained or instructed in the use of a fire extinguisher.
» They do not know what is burning.
» The fire is spreading rapidly.
» They do not have the proper equipment.
» They cannot do so without a means of escape.
» They may inhale toxic smoke.

b) Reporting procedures

In terms of the requirements of NEMA, the responsible person must, within 14 days of the incident, report to the Director General, provincial head of department and municipality.

» Report fire immediately to the site manager, who will determine if it is to be reported to the relevant emergency services and authorities.
» The site manager must have copies of the Report form to be completed.

SUMMARY: RESPONSE PROCEDURE

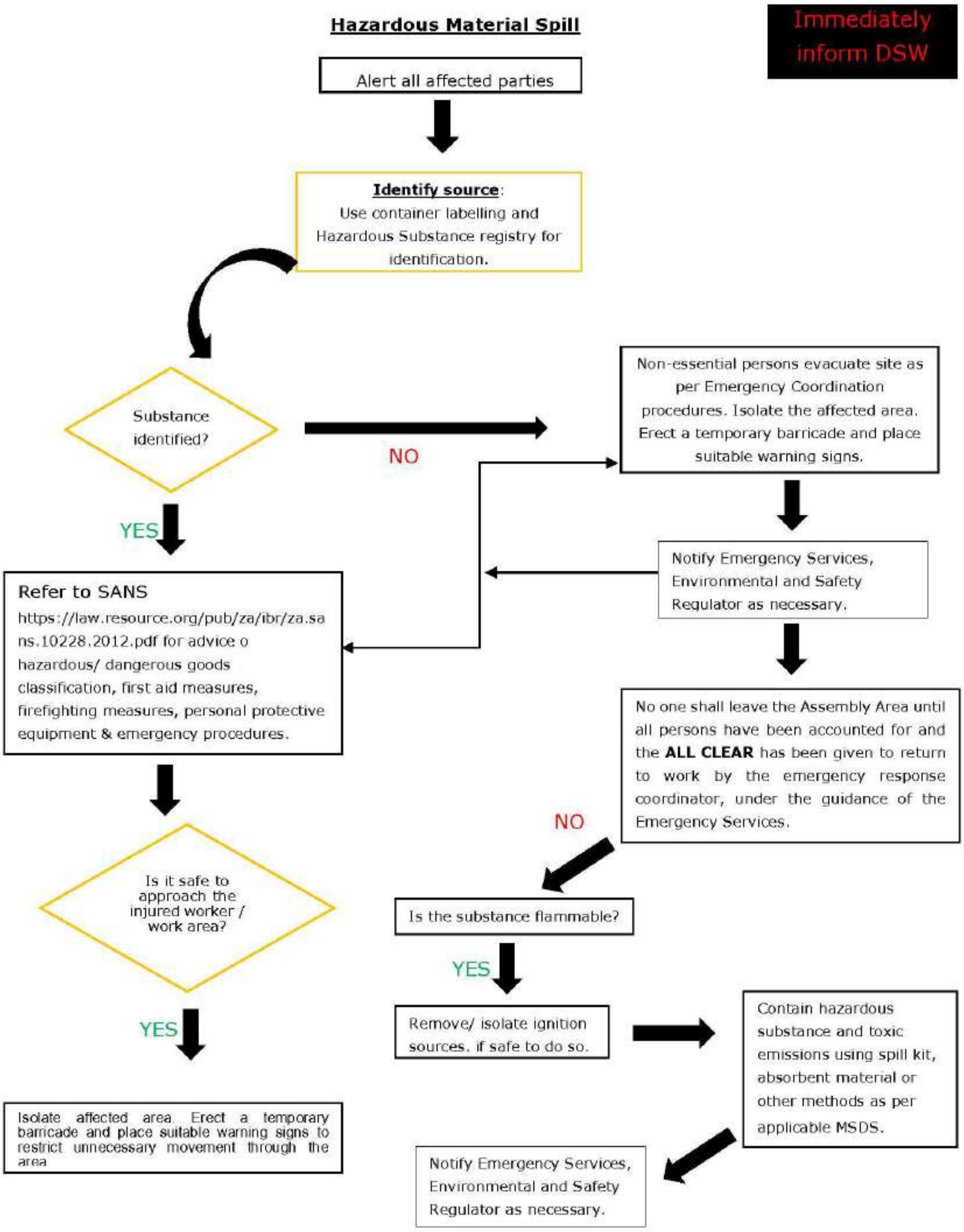

Figure 1: Hazardous Material Spill

Fire/Medical Emergency Situation

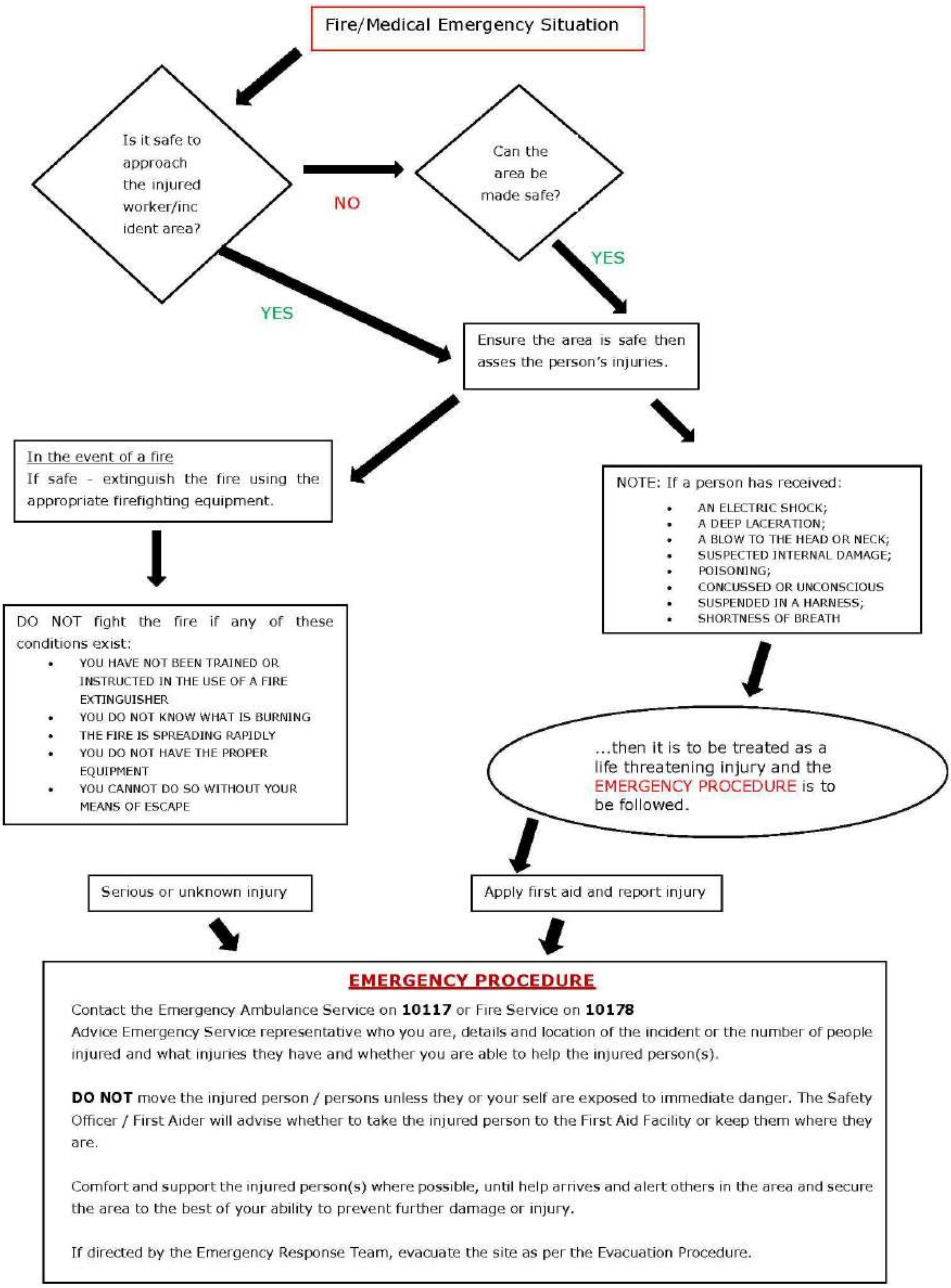

Figure 2: Emergency Fire/Medical

4. PROCEDURE RESPONSIBILITY

The Contractor's Safety, Health and Environment (SHE) Representative, employed by the Contractor, is responsible for managing the day-to-day on-site implementation of this Plan, and for the compilation of regular (usually weekly) Monitoring Reports. In addition, the SHE must act as liaison and advisor on all environmental and related issues.

The local authorities will provide their assistance when deemed necessary, or when it has been requested and/or indicated in Section 30 (8) of NEMA. The provincial authority will provide assistance and guidance where required and conduct awareness programmes.

5. SPECIFIC CONDITIONS

Prior to the commencement of construction, the following must be undertaken and updated herein or attached as an appendix to this plan as and where required:

- A recognised process hazard analysis (such as a HAZOP study) on the proposed facility prior to construction to ensure design and operational hazards have been identified and adequate mitigation put in place.
- Signature of all terminal designs must be undertaken by a professional engineer registered in South Africa in accordance with the Professional Engineers Act.
- A Major Hazardous Installation (MHI) Risk Assessment compiled in accordance with MHI regulations.
- An emergency preparedness and response document for on-site and off-site scenarios prior to initiating the MHI risk assessment.

APPENDIX K(K):
WASTE MANAGEMENT PLAN

WASTE MANAGEMENT PLAN

1. PURPOSE

A Waste Management Plan (WMP) plays a key role in achieving sustainable waste management throughout all phases of the project. The plan prescribes measures for the collection, temporary storage and safe disposal of the various waste streams associated with the project and includes provisions for the recovery, re-use and recycling of waste. The purpose of this plan is therefore to ensure that effective procedures are implemented for the handling, storage, transportation and disposal of waste generated from the project activities on site.

This WMP has been compiled as part of the project EMPr and is based on waste stream information available at the time of compilation. Construction and operation activities must be assessed on an ongoing basis in order to determine the efficacy of the plan and whether further revision of the plan is required. This plan should be updated once further detail regarding waste quantities and categorisation become available, during the construction and/or operation stages. This plan should be updated throughout the life-cycle of the Witberg WEF facility, as required in order to ensure that appropriate measures are in place to manage and control waste and to ensure compliance with relevant legislation.

Prior to the commencement of construction, a detailed Waste Management Method Statement for the site should be compiled by the Contractor.

2. RELEVANT ASPECTS OF THE SITE

It is expected that the development of the Witberg Wind Energy Facility will generate construction solid waste, as well as general waste and hazardous waste during the lifetime of the wind energy facility.

Waste generated on site, originates from various sources, including but not limited to:
- Concrete waste generated from spoil and excess concrete.
- Contaminated water, soil, rocks and vegetation due to hydrocarbon spills.
- Hazardous waste from vehicle, equipment and machinery parts and servicing, fluorescent tubes, used hydrocarbon containers, and waste ink cartridges.
- Recyclable waste in the form of paper, glass, steel, aluminium, wood/ wood pallets, plastic (PET bottles, PVC, LDPE) and cardboard.
- Organic waste from food waste as well as alien and endemic vegetation removal.
- Sewage from portable toilets and septic tanks.
- Inert waste from spoil material from site clearance and trenching works.

3. LEGISLATIVE REQUIREMENTS

Waste in South Africa is currently governed by several regulations, including:

- National Environmental Management: Waste Act (NEM:WA), 2008 (Act 59 of 2008);
- National Environmental Management: Waste Amendment Act, 2014 (Act 26 of 2014);
- The South African Constitution (Act 108 of 1996);
- Hazardous Substances Act (Act 5 of 1973);

» Health Act (Act 63 of 1977);
» Environment Conservation Act (Act 73 of 1989);
» Occupational Health and Safety Act (Act 85 of 1993);
» National Water Act (Act 36 of 1998);
» The National Environmental Management Act (Act 107 of 1998) (as amended);
» Municipal Structures Act (Act 117 of 1998);
» Municipal Systems Act (Act 32 of 2000);
» Mineral and Petroleum Resources Development Act (Act 28 of 2002); and
» Air Quality Act (Act 39 of 2004).

Storage of waste must be conducted in accordance with the National Norms and Standards for the Storage of Waste, published in GNR 926.

4. WASTE MANAGEMENT PRINCIPLES

An integrated approach to waste management is needed on site. Such an approach is illustrated in **Figure 1**.

It is important to ensure that waste is managed with the following objectives in mind during all phases of the project:

» Reducing volumes of waste is the greatest priority;
» If reduction is not feasible, the maximum amount of waste is to be recycled; and
» Waste that cannot be recycled is to be disposed of in the most environmentally responsible manner.

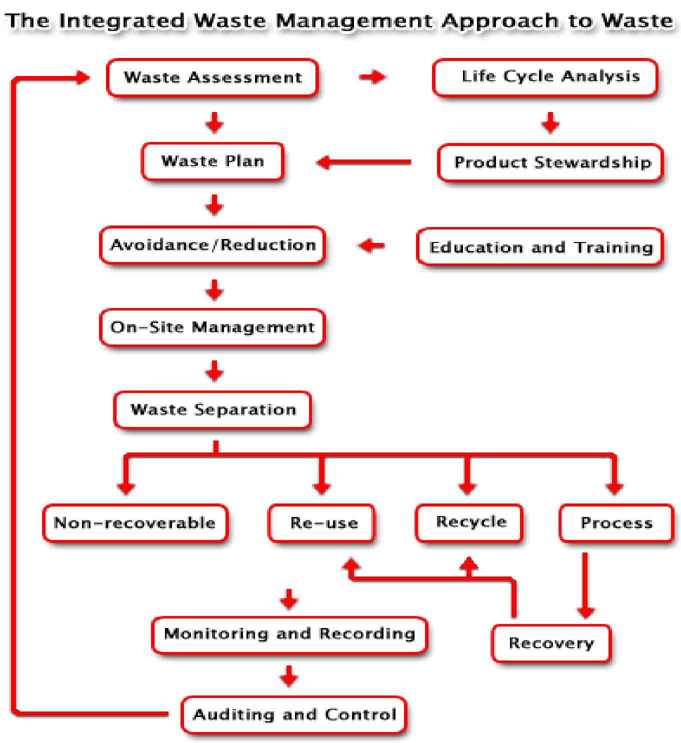

Figure 1: Integrated Waste Management Flow Diagram
(Source: http://www.enviroserv.co.za/pages/content.asp?SectionId=496)

4.1. Construction phase

A plan for the management of waste during the construction phase is detailed below. A Method Statement detailing specific waste management practices during construction should be prepared by the Contractor prior to the commencement of construction, for approval by the Resident Engineer.

4.1.1. Waste Assessment / Inventory

» The Environmental Officer (EO), or designated staff member, must develop, implement and maintain a waste inventory reflecting all waste generated during construction for both general and hazardous waste streams.
» Construction methods and materials should be carefully considered in view of waste reduction, re-use, and recycling opportunities, to be pro-actively implemented.
» Once a waste inventory has been established, targets for the recovery of waste (minimisation, re-use, recycling) should be set.
» The EO must conduct waste classification and rating in terms of SANS 10288 and Government Notice 634 published under the NEM: WA.

4.1.2. Waste collection, handling and storage

» It is the responsibility of the EO to ensure that each subcontractor implements their own waste recycling system, i.e. separate bins for food waste, plastics, paper, wood, glass cardboard, metals, etc. Such practises must be made contractually binding upon appointment of the subcontractors.
» Waste manifests and waste acceptance approvals (i.e. receipts) from designated waste facilities must be kept on file at the site office, in order to record and prove continual compliance for future auditing.
» Septic tanks and portable toilets must be monitored by the EO or responsible subcontractor and maintained regularly. Below ground storage of septic tanks must withstand the external forces of the surrounding environment. The area above the tank must be demarcated to prevent any vehicles or heavy machinery from moving around in the surrounding area.
» Waste collection bins and hazardous waste containers must be provided by the principal contractor and subcontractors and placed at strategic locations around the site for the storage of organic, recyclable and hazardous waste.
» A dedicated waste area must be established on site for the storage of all waste streams before removal from site. The storage period must not trigger listed waste activities as per the NEMWA, GN 921 of November 2013.
» Signage/ colour coding must be used to differentiate disposal areas for the various waste streams (i.e. paper, cardboard, metals, food waste, glass etc.).
» Hazardous waste must be stored within a bunded area constructed according to SABS requirements, and must ensure complete containment of the spilled material in the event of a breach. As such, appropriate bunding material, design, capacity and type must be utilised to ensure that no contamination of the surrounding environment will occur despite a containment breach. The net capacity of a bunded compound in a storage facility should be at least 120% of the net capacity of the largest tank.
» Take into consideration the capacity displaced by other tanks within the same bunded area and any foundations.

- Treat interconnected tanks as a single tank of equivalent total volume for the purposes of the bund design criteria.
- The location of all temporary waste storage areas must aim to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage, and vermin control, while being reasonably placed in terms of centrality and accessibility on site. Where required, an additional temporary waste storage area may be designated, provided identical controls are exercised for these locations.
- Waste storage shall be in accordance with all Regulations and best-practice guidelines and under no circumstances may waste be burnt on site.
- A dedicated waste management team must be appointed by the principal contractors' SHE Officer, who will be responsible for ensuring the continuous sorting of waste and maintenance of the area. The waste management team must be trained in all areas of waste management and monitored by the SHE Officer.
- All waste removed from site must be done by a registered/ licensed subcontractor, who must supply information regarding how waste recycling/ disposal will be achieved. The registered subcontractor must provide waste manifests for all removals at least once a month or for every disposal made, records of which must be kept on file at the site camp for the duration of the construction period.

4.1.3. Management of waste storage areas

- Waste storage must be undertaken in accordance with the relevant Norms and Standards.
- The position of all waste storage areas must be located so as to ensure minimal degradation to the environment. The main waste storage area must have a suitable storm water system separating clean and contaminated storm water.
- Collection bins placed around the site and at subcontractors' camps (if at a different location than the main site camp) must be maintained and emptied on a regular basis by the principal contractor to avoid overflowing receptacles.
- Inspections and maintenance of the main waste storage area must be undertaken daily. Skips and storage containers must be clearly marked or colour coded and well-maintained. Monitor for rodents and take corrective action if they become a problem.
- Waste must be stored in designated containers and not on the ground.
- Inspections and maintenance of bunds must be undertaken regularly. Bunds must be inspected for leaks or cracks in the foundation and walls.
- It is assumed that any rainwater collected inside the bund is contaminated and must be treated by oil/water separation (or similar method) prior to dewatering, or removed and stored as hazardous waste, and not released into the environment.
- If any leaks occur in the bund, these must be amended immediately.
- Bund systems must be designed to avoid dewatering of contaminated water, but to rather separate oil and hydrocarbons from water prior to dewatering.
- Following rainfall event bunds must always be dewatered in order to maintain a sufficient storage capacity in the event of a breach.
- No mixing of hazardous and general waste is allowed.

4.1.4. Disposal

- Waste generated on site must be removed on a regular basis. This frequency may change during construction depending on waste volumes generated at different stages of the construction process, however removal must occur prior to the storage capacity being reached to avoid overflow of containers and poor waste storage.

» Waste must be removed by a suitably qualified contractor and disposed of at an appropriately licensed landfill site. Proof of appropriate disposal must be provided by the contractor to the EO and ECO.

4.1.5. Record keeping

The success of the WMP is determined by measuring criteria such as waste volumes, cost recovery from recycling and cost of disposal. Recorded data can indicate the effect of training and education, or the need for education. It will provide trends and benchmarks for setting goals and standards. It will provide clear evidence of the success or otherwise of the plan.

» Documentation (waste manifest, certificate of issue or safe disposal) must be kept detailing the quantity, nature, and fate of any regulated waste for audit purposes.
» Waste management must form part of the monthly reporting requirements in terms of volumes generated, types, storage and final disposal.

4.1.6. Training

Training and awareness regarding waste management shall be provided to all employees and contractors as part of the toolbox talks or on-site awareness sessions with the EO and at the frequency as set out by the ECO.

4.2. Operation phase

It is expected that the operation phase will result in the production of limited amounts of general waste consisting mostly of cardboard, paper, plastic, tins, metals and a variety of synthetic compounds. Hazardous wastes (including grease, oils) will also be generated. All waste generated will be required to be temporarily stored at the facility in appropriate sealed containers prior to disposal at a permitted landfill site or other facilities.

The following waste management principles apply during the operation phase:

» The SHE Manager must develop, implement and maintain a waste inventory reflecting all waste generated during operation for both general and hazardous waste streams.
» Adequate waste collection bins at site must be supplied. Separate bins should be provided for general and hazardous waste.
» Recyclable waste must be removed from the waste stream and stored separately.
» All waste must be stored in appropriate temporary storage containers (separated between different operation wastes, and contaminated or wet waste).
» Waste storage shall be in accordance with all best-practice guidelines and under no circumstances may waste be burnt on site.
» Waste generated on site must be removed on a regular basis throughout the operation phase.
» Waste must be removed by a suitably qualified contractor and disposed of at an appropriately licensed landfill site. Proof of appropriate disposal must be provided by the contractor and kept on site.

5. Monitoring of Waste Management Activities

Records must be kept of the volumes/ mass of the different waste streams that are collected from the site throughout the life of the project. The appointed waste contractor is to provide monthly reports to the operator containing the following information:

- » Monthly volumes/ mass of the different waste streams collected;
- » Monthly volumes/ mass of the waste that is disposed of at a landfill site;
- » Monthly volumes/ mass of the waste that is recycled;
- » Data illustrating progress compared to previous months.

This report will aid in monitoring the progress and relevance of the waste management procedures that are in place. If it is found that the implemented procedures are not as effective as required, this WMP is to be reviewed and amended accordingly. This report must from part of the EO's reports to the ECO on a monthly basis.

APPENDIX K(L): CURRICULUM VITAE

1st Floor, Block 2, 5 Woodlands Drive Office Park
Woodlands Drive, Woodmead
Johannesburg, South Africa

Email: joanne@savannahsa.com
Tel: +27 (11) 656 3237

CURRICULUM VITAE OF JO-ANNE THOMAS

Profession:	Environmental Management and Compliance Consultant; Environmental Assessment Practitioner
Specialisation:	Environmental Management; Strategic environmental advice; Environmental compliance advice & monitoring; Environmental Impact Assessments; Policy, strategy & guideline formulation; Project Management; General Ecology
Work experience:	Twenty one (21) years in the environmental field

VOCATIONAL EXPERIENCE

Provide technical input for projects in the environmental management field, specialising in Strategic Environmental Advice, Environmental Impact Assessment studies, environmental auditing and monitoring, environmental permitting, public participation, Environmental Management Plans and Programmes, environmental policy, strategy and guideline formulation, and integrated environmental management. Key focus on integration of the specialist environmental studies and findings into larger engineering-based projects, strategic assessment, and providing practical and achievable environmental management solutions and mitigation measures. Responsibilities for environmental studies include project management (including client and authority liaison and management of specialist teams); review and manipulation of data; identification and assessment of potential negative environmental impacts and benefits; review of specialist studies; and the identification of mitigation measures. Compilation of the reports for environmental studies is in accordance with all relevant environmental legislation.

Undertaking of numerous environmental management studies has resulted in a good working knowledge of environmental legislation and policy requirements. Recent projects have been undertaken for both the public- and private-sector, including compliance advice and monitoring, electricity generation and transmission projects, various types of linear developments (such as National Road, local roads and power lines), waste management projects (landfills), mining rights and permits, policy, strategy and guideline development, as well as general environmental planning, development and management.

SKILLS BASE AND CORE COMPETENCIES

- Project management for a range of projects
- Identification and assessment of potential negative environmental impacts and benefits through the review and manipulation of data and specialist studies
- Identification of practical and achievable mitigation and management measures and the development of appropriate management plans
- Compilation of environmental reports in accordance with relevant environmental legislative requirements
- External and peer review of environmental reports & compliance advice and monitoring
- Formulation of environmental policies, strategies and guidelines
- Strategic and regional assessments; pre-feasibility & site selection
- Public participation processes for a variety of projects
- Strategic environmental advice to a wide variety of clients both in the public and private sectors
- Working knowledge of environmental planning processes, policies, regulatory frameworks and legislation

EDUCATION AND PROFESSIONAL STATUS

Degrees:

- B.Sc Earth Sciences, University of the Witwatersrand, Johannesburg (1993)
- B.Sc Honours in Botany, University of the Witwatersrand, Johannesburg (1994)
- M.Sc in Botany, University of the Witwatersrand, Johannesburg (1996)

Short Courses:

- Environmental Impact Assessment, Potchefstroom University (1998)
- Environmental Law, Morgan University (2001)
- Environmental Legislation, IMBEWU (2017)
- Mining Legislation, Cameron Cross & Associates (2013)
- Environmental and Social Risk Management (ESRM), International Finance Corporation (2018)

Professional Society Affiliations:

- Registered with the South African Council for Natural Scientific Professions as a Professional Natural Scientist: Environmental Scientist (400024/00)
- Registered with the International Associated for Impact Assessment South Africa (IAIAsa): 5601
- Member of the South African Wind Energy Association (SAWEA)

EMPLOYMENT

Date	Company	Roles and Responsibilities
January 2006 - Current	Savannah Environmental (Pty) Ltd	Director Project manager Independent specialist environmental consultant, Environmental Assessment Practitioner (EAP) and advisor.
1997 – 2005	Bohlweki Environmental (Pty) Ltd	Senior Environmental Scientist at. Environmental Management and Project Management
January – July 1997	Sutherland High School, Pretoria	Junior Science Teacher

PROJECT EXPERIENCE

Project experience includes large infrastructure projects, including electricity generation and transmission, wastewater treatment facilities, mining and prospecting activities, property development, and national roads, as well as strategy and guidelines development.

RENEWABLE POWER GENERATION PROJECTS: PHOTOVOLTAIC SOLAR ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Christiana PV 2 SEF, North West	Solar Reserve South Africa	Project Manager & EAP
De Aar PV facility, Northern Cape	iNca Energy	Project Manager & EAP
Everest SEF near Hennenman, Free State	FRV Energy South Africa	Project Manager & EAP
Graafwater PV SEF, Western Cape	iNca Energy	Project Manager & EAP
Grootkop SEF near Allanridge, Free State	FRV Energy South Africa	Project Manager & EAP
Hertzogville PV 2 SEF with 2 phases, Free State	SunCorp / Solar Reserve	Project Manager & EAP
Karoshoek CPV facility on site 2 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP

Project Name & Location	Client Name	Role
Kgabalatsane SEF North-East for Brits, North West	Built Environment African Energy Services	Project Manager & EAP
Kleinbegin PV SEF West of Groblershoop, Northern Cape	MedEnergy Global	Project Manager & EAP
Lethabo Power Station PV Installation, Free State	Eskom Holdings SoC Limited	Project Manager & EAP
Majuba Power Station PV Installation, Mpumalanga	Eskom Holdings SoC Limited	Project Manager & EAP
Merapi PV SEF Phase 1 – 4 South-East of Excelsior, Free State	SolaireDirect Southern Africa	Project Manager & EAP
Sannaspos Solar Park, Free State	SolaireDirect Southern Africa	Project Manager & EAP
Ofir-Zx PV Plant near Keimoes, Northern Cape	S28 Degrees Energy	Project Manager & EAP
Oryx SEF near Virginia, Free State	FRV Energy South Africa	Project Manager & EAP
Project Blue SEF North of Kleinsee, Northern Cape	WWK Development	Project Manager & EAP
S-Kol PV Plant near Keimoes, Northern Cape	S28 Degrees Energy	Project Manager & EAP
Sonnenberg PV Plant near Keimoes, Northern Cape	S28 Degrees Energy	Project Manager & EAP
Tutuka Power Station PV Installation, Mpumalanga	Eskom Transmission	Project Manager & EAP
Two PV sites within the Northern Cape	MedEnergy Global	Project Manager & EAP
Two PV sites within the Western & Northern Cape	iNca Energy	Project Manager & EAP
Upington PV SEF, Northern Cape	MedEnergy Global	Project Manager & EAP
Vredendal PV facility, Western Cape	iNca Energy	Project Manager & EAP
Waterberg PV plant, Limpopo	Thupela Energy	Project Manager & EAP
Watershed Phase I & II SEF near Litchtenburg, North West	FRV Energy South Africa	Project Manager & EAP
Alldays PV & CPV SEF Phase 1, Limpopo	BioTherm Energy	Project Manager & EAP
Hyperion PV Solar Development 1, 2, 3, 4, 5 & 6	Building Energy	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Aberdeen PV SEF, Eastern Cape	BioTherm Energy	Project Manager & EAP
Christiana PV 1 SEF on Hartebeestpan Farm, North-West	Solar Reserve South Africa	Project Manager & EAP
Heuningspruit PV1 & PV 2 facilities near Koppies, Free State	Sun Mechanics	Project Manager & EAP
Kakamas PV Facility, Northern Cape	iNca Energy	Project Manager & EAP
Kakamas II PV Facility, Northern Cape	iNca Energy	Project Manager & EAP
Machadodorp 1 PV SEF, Mpumalanga	Solar To Benefit Africa	Project Manager & EAP
PV site within the Northern Cape	iNca Energy	Project Manager & EAP
PV sites within 4 ACSA airports within South Africa, National	Airports Company South Africa (ACSA)	Project Manager & EAP
RustMo1 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
RustMo2 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
RustMo3 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
RustMo4 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
Sannaspos PV SEF Phase 2 near Bloemfontein, Free State	SolaireDirect Southern Africa	Project Manager & EAP
Solar Park Expansion within the Rooiwal Power Station, Gauteng	AFRKO Energy	Project Manager & EAP
Steynsrus SEF, Free State	SunCorp	Project Manager & EAP

Project Name & Location	Client Name	Role
Sirius Solar PV Project Three and Sirius Solar PV Project Four (BA in terms of REDZ regulations), Northern Cape	SOLA Future Energy	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Allemans Fontein SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Amandel SEF near Thabazimbi, Limpopo	iNca Energy	Project Manager & EAP
Arola/Doornplaat SEF near Ventersdorp, North West	FRV & iNca Energy	Project Manager & EAP
Bloemfontein Airport PV Installation, Free State	The Power Company	Project Manager & EAP
Brakspruit SEF near Klerksorp, North West	FRV & iNca Energy	Project Manager & EAP
Carolus Poort SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Damfontein SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Everest SEF near Welkom, Free State	FRV & iNca Energy	Project Manager & EAP
Gillmer SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Grootkop SEF near Allansridge, Free State	FRV & iNca Energy	Project Manager & EAP
Heuningspruit PV1 & PV 2 near Koppies, Free State	Cronimat	Project Manager & EAP
Kimberley Airport PV Installation, Northern Cape	The Power Company	Project Manager & EAP
Kolonnade Mall Rooftop PV Installation in Tshwane, Gauteng	Momentous Energy	Project Manager & EAP
Loskop SEF near Groblersdal, Limpopo	S&P Power Unit	Project Manager & EAP
Marble SEF near Marble Hall, Limpopo	S&P Power Unit	Project Manager & EAP
Morgenson PV1 SEF South-West of Windsorton, Northern Cape	Solar Reserve South Africa	Project Manager & EAP
OR Tambo Airport PV Installation, Gauteng	The Power Company	Project Manager & EAP
Oryx SEF near Virginia, Free State	FRV & iNca Energy	Project Manager & EAP
Rhino SEF near Vaalwater, Limpopo	S&P Power Unit	Project Manager & EAP
Rustmo2 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
Spitskop SEF near Northam, Limpopo	FRV & iNca Energy	Project Manager & EAP
Steynsrus PV, Free State	Suncorp	Project Manager & EAP
Tabor SEF near Polokwane, Limpopo	FRV & iNca Energy	Project Manager & EAP
UpingtonAirport PV Installation, Northern Cape	The Power Company	Project Manager & EAP
Valeria SEF near Hartebeestpoort Dam, North West	Solar to Benefit Africa	Project Manager & EAP
Watershed SEF near Lichtenburg, North West	FRV & iNca Energy	Project Manager & EAP
Witkop SEF near Polokwane, Limpopo	FRV & iNca Energy	Project Manager & EAP
Woodmead Retail Park Rooftop PV Installation, Gauteng	Momentous Energy	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO and bi-monthly auditing for the construction of the Adams Solar PV Project Two South of Hotazel, Northern Cape	Enel Green Power	Project Manager
ECO for the construction of the Kathu PV Facility, Northern Cape	REISA	Project Manager
ECO and bi-monthly auditing for the construction of the Pulida PV Facility, Free State	Enel Green Power	Project Manager
ECO for the construction of the RustMo1 SEF, North West	Momentous Energy	Project Manager
ECO for the construction of the Sishen SEF, Northern	Windfall 59 Properties	Project Manager

Project Name & Location	Client Name	Role
Cape		
ECO for the construction of the Upington Airport PV Facility, Northern Cape	Sublanary Trading	Project Manager
Quarterly compliance monitoring of compliance with all environmental licenses for the operation activities at the Kathu PV facility, Northern Cape	REISA	Project Manager
ECO for the construction of the Konkoonsies II PV SEF and associated infrastructure, Northern Cape	BioTherm Energy	Project Manager
ECO for the construction of the Aggeneys PV SEF and associated infrastructure, Northern Cape	BioTherm Energy	Project Manager

Compliance Advice and ESAP Reporting

Project Name & Location	Client Name	Role
Aggeneys Solar Farm, Northern Cape	BioTherm Energy	Environmental Advisor
Airies II PV Facility SW of Kenhardt, Northern Cape	BioTherm Energy	Environmental Advisor
Kalahari SEF Phase II in Kathu, Northern Cape	Engie	Environmental Advisor
Kathu PV Facility, Northern Cape	Building Energy	Environmental Advisor
Kenhardt PV Facility, Northern Cape	BioTherm Energy	Environmental Advisor
Kleinbegin PV SEF West of Groblershoop, Northern Cape	MedEnergy	Environmental Advisor
Konkoonises II SEF near Pofadder, Northern Cape	BioTherm Energy	Environmental Advisor
Konkoonsies Solar Farm, Northern Cape	BioTherm Energy	Environmental Advisor
Lephalale SEF, Limpopo	Exxaro	Environmental Advisor
Pixley ka Seme PV Park, South-East of De Aar, Northern Cape	African Clean Energy Developments (ACED)	Environmental Advisor
RustMo1 PV Plant near Buffelspoort, North West	Momentous Energy	Environmental Advisor
Scuitdrift 1 SEF & Scuitdrift 2 SEF, Limpopo	Building Energy	Environmental Advisor
Sirius PV Plants, Northern Cape	Aurora Power Solutions	Environmental Advisor
Upington Airport PV Power Project, Northern Cape	Sublunary Trading	Environmental Advisor
Upington SEF, Northern Cape	Abengoa Solar	Environmental Advisor
Ofir-ZX PV SEF near Keimoes, Northern Cape	Networx S28 Energy	Environmental Advisor
Steynsrus PV1 & PV2 SEF's, Northern Cape	Cronimet Power Solutions	Environmental Advisor
Heuningspruit PV SEF, Northern Cape	Cronimet Power Solutions	Environmental Advisor

Due Diligence Reporting

Project Name & Location	Client Name	Role
5 PV SEF projects in Lephalale, Limpopo	iNca Energy	Environmental Advisor
Prieska PV Plant, Northern Cape	SunEdison Energy India	Environmental Advisor
Sirius Phase One PV Facility near Upington, Northern Cape	Aurora Power Solutions	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Biodiversity Permit & WULA for the Aggeneys SEF near Aggeneys, Northern Cape	BioTherm Energy	Project Manager & EAP
Biodiversity Permit for the Konkoonises II SEF near Pofadder, Northern Cape	BioTherm Energy	Project Manager & EAP
Biodiversity Permitting for the Lephalale SEF, Limpopo	Exxaro Resources	Project Manager & EAP

Project Name & Location	Client Name	Role
Environmental Permitting for the Kleinbegin PV SEF West of Groblershoop, Northern Cape	MedEnergy	Project Manager & EAP
Environmental Permitting for the Upington SEF, Northern Cape	Abengoa Solar	Project Manager & EAP
Environmental Permitting for the Kathu PV Facility, Northern Cape	Building Energy	Project Manager & EAP
Environmental Permitting for the Konkoonsies Solar Farm, Northern Cape	BioTherm Energy	Project Manager & EAP
Environmental Permitting for the Lephalale SEF, Limpopo	Exxaro Resources	Project Manager & EAP
Environmental Permitting for the Scuitdrift 1 SEF & Scuitdrift 2 SEF, Limpopo	Building Energy	Project Manager & EAP
Environmental Permitting for the Sirius PV Plant, Northern Cape	Aurora Power Solutions	Project Manager & EAP
Environmental Permitting for the Steynsrus PV1 & PV2 SEF's, Northern Cape	Cronimet Power Solutions	Project Manager & EAP
Environmental Permitting for the Heuningspruit PV SEF, Northern Cape	Cronimet Power Solutions	Project Manager & EAP
Permits for the Kleinbegin and UAP PV Plants, Northern Cape	MedEnergy Global	Project Manager & EAP
S53 Application for Arriesfontein Solar Park Phase 1 – 3 near Danielskuil, Northern Cape	Solar Reserve / SunCorp	Project Manager & EAP
S53 Application for Hertzogville PV1 & PV 2 SEFs, Free State	Solar Reserve / SunCorp	Project Manager & EAP
S53 Application for the Bloemfontein Airport PV Facility, Free State	Sublunary Trading	Project Manager & EAP
S53 Application for the Kimberley Airport PV Facility, Northern Cape	Sublunary Trading	Project Manager & EAP
S53 Application for the Project Blue SEF, Northern Cape	WWK Developments	Project Manager & EAP
S53 Application for the Upington Airport PV Facility, Free State	Sublunary Trading	Project Manager & EAP
WULA for the Kalahari SEF Phase II in Kathu, Northern Cape	Engie	Project Manager & EAP
Environmental Permitting for the Steynsrus PV1 & PV2 SEF's, Northern Cape	Cronimet Power Solutions	Project Manager & EAP
Environmental Permitting for the Heuningspruit PV SEF, Northern Cape	Cronimet Power Solutions	Project Manager & EAP

RENEWABLE POWER GENERATION PROJECTS: CONCENTRATED SOLAR FACILITIES (CSP)

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Ilanga CSP 2, 3, 4, 5, 7 & 9 Facilities near Upington, Northern Cape	Emvelo Holdings	Project Manager & EAP
Ilanga CSP near Upington, Northern Cape	Ilangethu Energy	Project Manager & EAP
Ilanga Tower 1 Facility near Upington, Northern Cape	Emvelo Holdings	Project Manager & EAP

Project Name & Location	Client Name	Role
Karoshoek CPVPD 1-4 facilities on site 2 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Karoshoek CSP facilities on sites 1.4; 4 & 5 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Karoshoek Linear Fresnel 1 Facility on site 1.1 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the !Khi CSP Facility, Northern Cape	Abengoa Solar	Project Manager
ECO for the construction of the Ilanga CSP 1 Facility near Upington, Northern Cape	Karoshoek Solar One	Project Manager
ECO for the construction of the folar Park, Northern Cape	Kathu Solar	Project Manager
ECO for the construction of the KaXu! CSP Facility, Northern Cape	Abengoa Solar	Project Manager
Internal audit of compliance with the conditions of the IWUL issued to the Karoshoek Solar One CSP Facility, Northern Cape	Karoshoek Solar One	Project Manager

Screening Studies

Project Name & Location	Client Name	Role
Upington CSP (Tower) Plant near Kanoneiland, Northern Cape	iNca Energy and FRV	Project Manager & EAP

Compliance Advice and ESAP reporting

Project Name & Location	Client Name	Role
Ilanga CSP Facility near Upington, Northern Cape	Ilangethu Energy	Environmental Advisor
Ilangalethu CSP 2, Northern Cape	FG Emvelo	Environmental Advisor
Kathu CSP Facility, Northern Cape	GDF Suez	Environmental Advisor
Lephalale SEF, Limpopo	Cennergi	Environmental Advisor
Solis I CSP Facility, Northern Cape	Brightsource	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Environmental Permitting for the Ilanga CSP Facility near Upington, Northern Cape	Ilangethu Energy	Project Manager & EAP
Environmental Permitting for the Kathu CSP, Northern Cape	GDF Suez	Project Manager & EAP
WULA for the Solis I CSP Facility, Northern Cape	Brightsource	Project Manager & EAP

RENEWABLE POWER GENERATION PROJECTS: WIND ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Sere WEF, Western Cape	Eskom Holdings SoC Limited	EAP

Project Name & Location	Client Name	Role
Aberdeen WEF, Eastern Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Amakhala Emoyeni WEF, Eastern Cape	Windlab Developments	Project Manager & EAP
EXXARO West Coast WEF, Western Cape	EXXARO Resources	Project Manager & EAP
Goereesoe Wind Farm near Swellendam, Western Cape	iNca Energy	Project Manager & EAP
Hartneest WEF, Western Cape	Juwi Renewable Energies	Project Manager & EAP
Hopefield WEF, Western Cape	Umoya Energy	EAP
Kleinsee WEF, Northern Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Klipheuwel/Dassiesfontein WEF within the Overberg area, Western Cape	BioTherm Energy	Project Manager & EAP
Moorreesburg WEF, Western Cape	iNca Energy	Project Manager & EAP
Oyster Bay WEF, Eastern Cape	Renewable Energy Resources Southern Africa	Project Manager & EAP
Project Blue WEF, Northern Cape	Windy World	Project Manager & EAP
Rheboksfontein WEF, Western Cape	Moyeng Energy	Project Manager & EAP
Spitskop East WEF near Riebeeck East, Eastern Cape	Renewable Energy Resources Southern Africa	Project Manager & EAP
Suurplaat WEF, Western Cape	Moyeng Energy	Project Manager & EAP
Swellendam WEF, Western Cape	IE Swellendam	Project Manager & EAP
Tsitsikamma WEF, Eastern Cape	Exxarro	Project Manager & EAP
West Coast One WEF, Western Cape	Moyeng Energy	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Amakhala Emoyeni Wind Monitoring Masts, Eastern Cape	Windlab Developments	Project Manager & EAP
Beaufort West Wind Monitoring Masts, Western Cape	Umoya Energy	Project Manager & EAP
Hopefield Community Wind Farm near Hopefield, Western Cape	Umoya Energy	Project Manager & EAP
Koekenaap Wind Monitoring Masts, Western Cape	EXXARO Resources	Project Manager & EAP
Koingnaas WEF, Northern Cape	Just Palm Tree Power	Project Manager & EAP
Laingsburg Area Wind Monitoring Masts, Western Cape	Umoya Energy	Project Manager & EAP
Overberg Area Wind Monitoring Masts, Western Cape	BioTherm Energy	Project Manager & EAP
Oyster Bay Wind Monitoring Masts, Eastern Cape	Renewable Energy Systems Southern Africa (RES)	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Albertinia WEF, Western Cape	BioTherm Energy	Project Manager & EAP
Koingnaas WEF, Northern Cape	Just Pal Tree Power	Project Manager & EAP
Napier Region WEF Developments, Western Cape	BioTherm Energy	Project Manager & EAP
Tsitsikamma WEF, Eastern Cape	Exxarro Resources	Project Manager & EAP
Various WEFs within an identified area in the Overberg area, Western Cape	BioTherm Energy	Project Manager & EAP
Various WEFs within an identified area on the West Coast, Western Cape	Investec Bank Limited	Project Manager & EAP
Various WEFs within an identified area on the West Coast, Western Cape	Eskom Holdings Limited	Project Manager & EAP

Project Name & Location	Client Name	Role
Various WEFs within the Western Cape	Western Cape Department of Environmental Affairs and Development Planning	Project Manager & EAP
Velddrift WEF, Western Cape	VentuSA Energy	Project Manager & EAP
Wind 1000 Project	Thabo Consulting on behalf of Eskom Holdings	Project Manager & EAP
Wittekleibosch, Snylip & Doriskraal WEFs, Eastern Cape	Exxarro Resources	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the West Coast One WEF, Western Cape	Aurora Wind Power	Project Manager
ECO for the construction of the Gouda WEF, Western Cape	Blue Falcon	Project Manager
EO for the Dassiesklip Wind Energy Facility, Western Cape	Group 5	Project Manager
Quarterly compliance monitoring of compliance with all environmental licenses for the operation activities at the Gouda Wind Energy facility near Gouda, Western Cape	Blue Falcon	Project Manager
Annual auditing of compliance with all environmental licenses for the operation activities at the West Coast One Wind Energy facility near Vredenburg, Western Cape	Aurora Wind Power	Project Manager
External environmental and social audit for the Amakhala Wind Farm, Eastern Cape	Cennergi	Project Manager
External environmental and social audit for the Tsitsikamma Wind Farm, Eastern Cape	Cennergi	Project Manager
ECO for the construction of the Excelsior Wind Farm and associated infrastructure, Northern Cape	BioTherm Energy	Project Manager
External compliance audit of the Dassiesklip Wind Energy Facility, Western Cape	BioTherm Energy	Project Manager

Compliance Advice

Project Name & Location	Client Name	Role
Amakhala Phase 1 WEF, Eastern Cape	Cennergi	Environmental Advisor
Dassiesfontein WEF within the Overberg area, Western Cape	BioTherm Energy	Environmental Advisor
Excelsior Wind Farm, Western Cape	BioTherm Energy	Environmental Advisor
Great Karoo Wind Farm, Northern Cape	African Clean Energy Developments (ACED)	Environmental Advisor
Hopefield Community WEF, Western Cape	African Clean Energy Developments (ACED)	Environmental Advisor
Rheboksfontein WEF, Western Cape	Moyeng Energy	Environmental Advisor
Tiqua WEF, Western Cape	Cennergi	Environmental Advisor
Tsitsikamma WEF, Eastern Cape	Cennergi	Environmental Advisor
West Coast One WEF, Western Cape	Moyeng Energy	Environmental Advisor

Due Diligence Reporting

Project Name & Location	Client Name	Role
Witteberg WEF, Western Cape	EDPR Renewables	Environmental Advisor
IPD Vredenburg WEF within the Saldanha Bay area, Western Cape	IL&FS Energy Development Company	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Biodiversity Permitting for the Power Line between the Tsitikamma Community WEF & the Diep River Substation, Eastern Cape	Cennergi	Project Manager & EAP
Biodiversity Permitting for the West Coast One WEF, Western Cape	Aurora Wind Power	Project Manager & EAP
Environmental Permitting for the Excelsior WEF, Western Cape	BioTherm Energy	Project Manager & EAP
Plant Permits & WULA for the Tsitsikamma Community WEF, Eastern Cape	Cennergi	Project Manager & EAP
S24G and WULA for the Rectification for the commencement of unlawful activities on Ruimsig AH in Honeydew, Gauteng	Hossam Soror	Project Manager & EAP
S24G Application for the Rheboksfontein WEF, Western Cape	Ormonde - Theo Basson	Project Manager & EAP
S53 Application & WULA for Suurplaat and Gemini WEFs, Northern Cape	Engie	Project Manager & EAP
S53 Application for the Hopefield Community Wind Farm near Hopefield, Western Cape	Umoya Energy	Project Manager & EAP
S53 Application for the Project Blue WEF, Northern Cape	WWK Developments	Project Manager & EAP
S53 for the Oyster Bay WEF, Eastern Cape	RES	Project Manager & EAP
WULA for the Great Karoo Wind Farm, Northern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP

CONVENTIONAL POWER GENERATION PROJECTS (COAL)

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Mutsho Power Station near Makhado, Limpopo	Mutsho Consortium	Project Manager & EAP
Coal-fired Power Station near Ogies, Mpumalanga	Ruukki SA	Project Manager & EAP
Thabametsi IPP Coal-fired Power Station, near Lephalale, Limpopo	Axia	Project Manager & EAP
Transalloys Coal-fired Power Station, Mpumalanga	Transalloys	Project Manager & EAP
Tshivasho IPP Coal-fired Power Station (with WML), near Lephalale, Limpopo	Cennergi	Project Manager & EAP
Umbani Coal-fired Power Station, near Kriel, Mpumalanga	ISS Global Mining	Project Manager & EAP
Waterberg IPP Coal-Fired Power Station near Lephalale, Limpopo	Exxaro Resources	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Coal Stockyard on Medupi Ash Dump Site, Limpopo	Eskom Holdings	Project Manager & EAP

Project Name & Location	Client Name	Role
Biomass Co-Firing Demonstration Facility at Arnot Power Station East of Middleburg, Mpumlanaga	Eskom Holdings	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Baseload Power Station near Lephalale, Limpopo	Cennergi	Project Manager & EAP
Coal-Fired Power Plant near Delmas, Mpumalanga	Exxaro Resources	Project Manager & EAP
Makhado Power Station, Limpopo	Mutsho Consortium, Limpopo	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the Camden Power Station, Mpumalanga	Eskom Holdings	Project Manager

Compliance Advice

Project Name & Location	Client Name	Role
Thabametsi IPP Coal-fired Power Station, near Lephalale, Limpopo	Axia	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Permit application for the Thabametsi Bulk Water Pipeline, near Lephalale, Limpopo	Axia	Project Manager & EAP
S53 & WULA for the Waterberg IPP Coal-Fired Power Station near Lephalale, Limpopo	Exxaro Resources	Project Manager & EAP
S53 Application for the Tshivasho Coal-fired Power Station near Lephalale, Limpopo	Cennergi	Project Manager & EAP

<u>CONVENTIONAL POWER GENERATION PROJECTS (GAS)</u>

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Ankerlig OCGT to CCGT Conversion project &400 kV transmission power line between Ankerlig and the Omega Substation, Western Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Gourikwa OCGT to CCGT Conversion project & 400 kV transmission power line between Gourikwa & Proteus Substation, Western Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Richards Bay Gas to Power Combined Cycle Power Station, KwaZulu-Natal	Eskom Holdings SoC Limited	Project Manager & EAP
Richards Bay Gas to Power Plant, KwaZulu-Natal	Richards Bay Gas	Project Manager & EAP
Decommissioning & Recommissioning of 3 Gas Turbine Units at Acacia Power Station & 1 Gas Turbine Unit at Port Rex Power Station to the existing Ankerlig Power Station in Atlantis Industria, Western Cape	Eskom Holdings	Project Manager & EAP
Two 132kV Chickadee Lines to the new Zonnebloem Switching Station, Mpumalanga	Eskom Holdings	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Fatal Flaw Analysis for 3 area identified for the establishment of a 500MW CCGT Power Station	Globeleq Advisors Limited	Project Manager & EAP
Richards Bay Gas to Power Combined Cycle Power Station, KwaZulu-Natal	Eskom Holdings SoC Limited	Project Manager & EAP

GRID INFRASTRUCTURE PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Aggeneis-Oranjemond Transmission Line & Substation Upgrade, Northern Cape	Eskom Transmission	Project Manager & EAP
Ankerlig-Omega Transmission Power Lines, Western Cape	Eskom Transmission	Project Manager & EAP
Karoshoek Grid Integration project as part of the Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Koeberg-Omega Transmission Power Lines,, Western Cape	Eskom Transmission	Project Manager & EAP
Koeberg-Stikland Transmission Power Lines, Western Cape	Eskom Transmission	Project Manager & EAP
Kyalami Strengthening Project, Gauteng	Eskom Transmission	Project Manager & EAP
Mokopane Integration Project, Limpopo	Eskom Transmission	Project Manager & EAP
Saldanha Bay Strengthening Project, Western Cape	Eskom Transmission	Project Manager & EAP
Steelpoort Integration Project, Limpopo	Eskom Transmission	Project Manager & EAP
Transmission Lines from the Koeberg-2 Nuclear Power Station site, Western Cape	Eskom Transmission	Project Manager & EAP
Tshwane Strengthening Project, Phase 1, Gauteng	Eskom Transmission	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Dassenberg-Koeberg Power Line Deviation from the Koeberg to the Ankerlig Power Station, Western Cape	Eskom Holdings	Project Manager & EAP
Golden Valley II WEF Power Line & Substation near Cookhouse, Eastern Cape	BioTherm Energy	Project Manager & EAP
Golden Valley WEF Power Line near Cookhouse, Eastern Cape	BioTherm Energy	Project Manager & EAP
Karoshoek Grid Integration project as part of the Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Konkoonsies II PV SEF Power Line to the Paulputs Substation near Pofadder, Northern Cape	BioTherm Energy	Project Manager & EAP
Perdekraal West WEF Powerline to the Eskom Kappa Substation, Westnern Cape	BioTherm Energy	Project Manager & EAP
Rheboksfontein WEF Powerline to the Aurora Substation, Western Cape	Moyeng Energy	Project Manager & EAP
Soetwater Switching Station near Sutherland, Northern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP

Solis Power I Power Line & Switchyard Station near Upington, Northern Cape	Brightsource	Project Manager & EAP
Stormwater Canal System for the Ilanga CSP near Upington, Northern Cape	Karoshoek Solar One	Project Manager & EAP
Tsitsikamma Community WEF Powerline to the Diep River Substation, Eastern Cape	Eskom Holdings	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the Ferrum-Mookodi Transmission Line, Northern Cape and North West	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Gamma-Kappa Section A Transmission Line, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Gamma-Kappa Section B Transmission Line, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Hydra IPP Integration project, Northern Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Kappa-Sterrekus Section C Transmission Line, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Namaqualand Strengthening project in Port Nolloth, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
ECO for the construction of the Neptune Substation Soil Erosion Mitigation Project, Eastern Cape	Eskom	Project Manager
ECO for the construction of the Ilanga-Gordonia 132kV power line, Northern Cape	Karoshoek Solar One	Project Manager

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Environmental Permitting and WULA for the Rockdale B Substation & Loop in Power Lines,	Eskom Holdings	Project Manager & EAP
Environmental Permitting and WULA for the Steelpoort Integration project, Limpopo	Eskom Holdings	Project Manager & EAP
Environmental Permitting for Solis CSP near Upington, Northern Cape	Brightsource	Project Manager & EAP

MINING SECTOR PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Elitheni Coal Mine near Indwe, Eastern Cape	Elitheni Coal	Project Manager & EAP
Groot Letaba River Development Project Borrow Pits	Iiso	Project Manager & EAP
Grootegeluk Coal Mine for coal transportation infrastructure between the mine and Medupi Power Station (EMPr amendment) , Limpopo	Eskom Holdings	Project Manager & EAP
Waterberg Coal Mine (EMPr amendment), Limpopo	Seskoko Resources	Project Manager & EAP
Aluminium Plant WML & AEL, Gauteng	GfE-MIR Alloys & Minerals	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Rare Earth Separation Plant in Vredendal, Western Cape	Rareco	Project Manager & EAP

Decommissioning and Demolition of Kilns 5 & 6 at the Slurry Plant, Kwa-Zulu Natal	PPC	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the Duhva Mine Water Recovery Project, Mpumalanga	Eskom Holdings SoC Limited	Project Manager
External compliance audit of Palesa Coal Mine's Integrated Water Use License (IWUL), near KwaMhlanga, Mpumalanga	HCI Coal	Project Manager
External compliance audit of Palesa Coal Mine's Waste Management License (WML) and EMP, near KwaMhlanga, Mpumalanga	HCI Coal	Project Manager
External compliance audit of Mbali Coal Mine's Integrated Water Use License (IWUL), near Ogies, Mpumalanga	HCI Coal	Project Manager
Independent External Compliance Audit of Water Use License (WUL) for the Tronox Namakwa Sands (TNS) Mining Operations (Brand se Baai), Western Cape	Tronox Namakwa Sands	Project Manager
Independent External Compliance Audit of Water Use License (WUL) for the Tronox Namakwa Sands (TNS) Mineral Separation Plant (MSP), Western Cape	Tronox Namakwa Sands	Project Manager
Independent External Compliance Audit of Water Use License (WUL) for the Tronox Namakwa Sands (TNS) Smelter Operations (Saldanha), Western Cape	Tronox Namakwa Sands	Project Manager
Compliance Auditing of the Waste Management Licence for the PetroSA Landfill Site at the GTL Refinery, Western Cape	PetroSA	Project Manager

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Waste Licence Application for the Rare Earth Separation Plant in Vredendal, Western Cape	Rareco	Project Manager & EAP
WULA for the Expansion of the Landfill site at Exxaro's Namakwa Sands Mineral Separation Plant, Western Cape	Exxaro Resources	Project Manager & EAP
S24G & WML for an Aluminium Plant, Gauteng	GfE-MIR Alloys & Minerals	Project Manager & EAP

<u>INFRASTRUCTURE DEVELOPMENT PROJECTS (BRIDGES, PIPELINES, ROADS, WATER RESOURCES, STORAGE, ETC)</u>

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Bridge across the Ngotwane River, on the border of South Africa and Botswana	Eskom Holdings	Project Manager & EAP
Chemical Storage Tanks, Metallurgical Plant Upgrade & Backfill Plant upgrade at South Deep Gold Mine, near Westonaria, Gauteng	Goldfields	Project Manager & EAP
Expansion of the existing Welgedacht Water Care Works, Gauteng	ERWAT	Project Manager & EAP

Project Name & Location	Client Name	Role
Golden Valley WEF Access Road near Cookhouse, Eastern Cape	BioTherm Energy	Project Manager & EAP
Great Fish River Wind Farm Access Roads and Watercourse Crossings near Cookhouse, Eastern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP
Ilanga CSP Facility Watercourse Crossings near Upington, Northern Cape	Karoshoek Solar one	Project Manager & EAP
Modification of the existing Hartebeestfontein Water Care Works, Gautng	ERWAT	Project Manager & EAP
N10 Road Realignment for the Ilanga CSP Facility, East of Upington, Northern Cape	SANRAL	Project Manager & EAP
Nxuba (Bedford) Wind Farm Watercourse Crossings near Cookhouse, Eastern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP
Pollution Control Dams at the Medupi Power Station Ash Dump & Coal Stockyard, Limpopo	Eskom	Project Manager & EAP
Qoboshane borrow pits (EMPr only), Eastern Cape	Emalahleni Local Municipality	Project Manager & EAP
Tsitsikamma Community WEF Watercourse Crossings, Eastern Cape	Cennergi	Project Manager & EAP
Clayville Central Steam Plant, Gauteng	Bellmall Energy	Project Manager & EAP
Msenge Emoyeni Wind Farm Watercourse Crossings and Roads, Eastern Cape	Windlab	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Harmony Gold WWTW at Doornkop Mine, Gauteng	Harmony Doornkop Plant	Project Manager & EAP
Ofir-ZX Watercourse Crossing for the Solar PV Facility, near Keimoes, Northern Cape	Networx S28 Energy	Project Manager & EAP
Qoboshane bridge & access roads, Eastern Cape	Emalahleni Local Municipality	Project Manager & EAP
Relocation of the Assay Laboratory near Carletonville, Gauteng	Sibanye Gold	Project Manager & EAP
Richards Bay Harbour Staging Area, KwaZulu-Natal	Eskom Holdings	Project Manager & EAP
S-Kol Watercourse Crossing for the Solar PV Facility, East of Keimoes, Northern Cape	Networx S28 Energy	Project Manager & EAP
Sonnenberg Watercourse Crossing for the Solar PV Facility, West Keimoes, Northern Cape	Networx S28 Energy	Project Manager & EAP
Kruisvallei Hydroelectric Power Generation Scheme, Free State	Building Energy	Project Manager & EAP
Masetjaba Water Reservoir, Pump Station and Bulk Supply Pipeline near Nigel, Gauteng	Naidu Consulting Engineers	Project Manager & EAP
Access Road for the Dwarsug Wind Farm, Northern Cape Province	South Africa Mainsteam Renewable Power	Project Manager & EAP
Upgrade of the Cooling Water Treatment Facility at the Kriel Power Station, Mpumalanga	Eskom	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Roodepoort Open Space Optimisation Programme (OSOP) Precinct, Gauteng	TIMAC Engineering Projects	Project Manager & EAP
Vegetable Oil Plant and Associated Pipeline, Kwa-Zulu Natal	Wilmar Oils and Fats Africa	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO and bi-monthly auditing for the construction of the Olifants River Water Resources Development Project (ORWRDP) Phase 2A: De Hoop Dam, R555 realignment and housing infrastructure	Department of Water and Sanitation	Project Manager Auditor
ECO for the Rehabilitation of the Blaaupan & Storm Water Channel, Gauteng	Airports Company of South Africa (ACSA)	Project Manager
Due Diligence reporting for the Better Fuel Pyrolysis Facility, Gauteng	Better Fuels	Project Manager
ECO for the Construction of the Water Pipeline from Kendal Power Station to Kendal Pump Station, Mpumalanga	Transnet	Project Manager
ECO for the Replacement of Low-Level Bridge, Demolition and Removal of Artificial Pong, and Reinforcement the Banks of the Crocodile River at the Construction at Walter Sisulu National Botanical Gardens, Gauteng Province	South African National Biodiversity Institute (SANBI)	Project Manager
External Compliance Audit of the Air Emission Licence (AEL) for a depot in Bloemfontein, Free State Province and in Tzaneen, Mpumalanga Province	PetroSA	Project Manager

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
WULA for the Izubulo Private Nature Reserve, Limpopo	Kjell Bismeyer, Jann Bader, Laurence Saad	Project Manager & EAP
WULA for the Masodini Private Game Lode, Limpopo	Masodini Private Game Lodge	Environmental Advisor
WULA for the Ezulwini Private Nature Reserve, Limpopo	Ezulwini Investments	Project Manager & EAP
WULA for the Masodini Private Game Lode, Limpopo	Masodini Private Game Lodge	Project Manager & EAP
WULA for the N10 Realignment at the Ilanga SEF, Northern Cape	Karoshoek Solar One	Project Manager & EAP
WULA for the Kruisvallei Hydroelectric Power Generation Scheme, Free State	Building Energy	Project Manager & EAP
S24G and WULA for the Ilegal construction of structures within a watercourse on EFF 24 Ruimsig Agricultural Holdings, Gauteng	Sorror Language Services	Project Manager & EAP

<u>HOUSING AND URBAN PROJECTS</u>

Basic Assessments

Project Name & Location	Client Name	Role
Postmasburg Housing Development, Northern Cape	Transnet	Project Manager & EAP

Compliance Advice and reporting

Project Name & Location	Client Name	Role
Kampi ya Thude at the Olifants West Game Reserve, Limpopo	Nick Elliot	Environmental Advisor

Project Name & Location	Client Name	Role
External Compliance Audit of WUL for the Johannesburg Country Club, Gauteng	Johannesburg Country Club	Project Manager

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
Due Diligence Audit for the Due Diligence Audit Report, Gauteng	Delta BEC (on behalf of Johannesburg Development Agency (JDA))	Project Manager

ENVIRONMENTAL MANAGEMENT TOOLS

Project Name & Location	Client Name	Role
Development of the 3rd Edition Environmental Implementation Plan (EIP)	Gauteng Department of Agriculture and Rural Development (GDARD)	Project Manager & EAP
Development of Provincial Guidelines on 4x4 routes, Western Cape	Western Cape Department of Environmental Affairs and Development Planning	EAP
Compilation of Construction and Operation EMP for the Braamhoek Transmission Integration Project, Kwazulu-Natal	Eskom Holdings	Project Manager & EAP
Compilation of EMP for the Wholesale Trade of Petroleum Products, Gauteng	Munaca Technologies	Project Manager & EAP
Operational Environmental Management Programme (OEMP) for Medupi Power Station, Limpopo	Eskom Holdings	Project Manager & EAP
Operational Environmental Management Programme (OEMP) for the Dube TradePort Site Wide Precinct	Dube TradePort Corporation	Project Manager & EAP
Operational Environmental Management Programme (OEMP) for the Kusile Power Station, Mpumalanga	Eskom Holdings	Project Manager & EAP
Review of Basic Assessment Process for the Wittekleibosch Wind Monitoring Mast, Eastern Cape	Exxaro Resources	Project Manager & EAP
Revision of the EMPr for the Sirius Solar PV	Aurora Power Solutions	Project Manager & EAP
State of the Environment (SoE) for Emalahleni Local Municipality, Mpumalanga	Simo Consulting on behalf of Emalahleni Local Municipality	Project Manager & EAP
Aspects and Impacts Register for Salberg Concrete Products operations	Salberg Concrete Products	EAP
First State of Waste Report for South Africa	Golder on behalf of the Department of Environmental Affairs	Project Manager & EAP
Responsibilities Matrix and Gap Analysis for the Kruisvallei Hydroelectric Power Generation Scheme, Free State Province	Building Energy	Project Manager
Responsibilities Matrix and Gap Analysis for the Roggeveld Wind Farm, Northern & Western Cape Provinces	Building Energy	Project Manager

PROJECTS OUTSIDE OF SOUTH AFRICA

Project Name & Location	Client Name	Role
Advisory Services for the Zizabona Transmission Project, Zambia, Zimbabwe, Botswana & Namibia	PHD Capital	Advisor
EIA for the Semonkong WEF, Lesotho	MOSCET	Project Manager & EAP
EMP for the Kuvaninga Energia Gas Fired Power Project, Mozambique	ADC (Pty) Ltd	Project Manager & EAP
Environmental Screening Report for the SEF near Thabana Morena, Lesotho	Building Energy	EAP
EPBs for the Kawambwa, Mansa, Mwense and Nchelenge SEFs in Luapula Province, Zambia	Building Energy	Project Manager & EAP
ESG Due Diligence for the Hilton Garden Inn Development in Windhoek, Namibia	Vatange Capital	Project Manager
Mandahill Mall Rooftop PV SEF EPB, Lusaka, Zambia	Building Energy	Project Manager & EAP
Monthly ECO for the PV Power Plant for the Mocuba Power Station	Scatec	Project Manager

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ID 8402275018083

Werner C. Marais

Summary of qualifications

Late 2009 *University of Johannesburg*
Started PhD (Biodiversity and Conservation) – Still in progress

2008 *University of Johannesburg*
MSc (Biodiversity and Conservation)

2006 *University of Johannesburg*
Hons (Biodiversity and Conservation)

2005 *University of Johannesburg*
BSc (Zoology and Botany)

Education

PhD (Biodiversity and Conservation)

- In-depth study of the subterranean and epiphereal ecosystems of caves and their surrounding environments in the Gauteng province, and more specifically the Carletonville Dolomite Grassland vegetation unit.
- Special reference is paid to cave dwelling bats and their specific conservation needs inside as well as outside caves, where foraging takes place.
- A thorough understanding of grassland ecology as well as mammalian biology/behavior is essential for the study.
- The impacts of urbanisation on cave bat colonies are an essential focus of the research.
- Strong ecological focus.

MSc (Biodiversity and Conservation)

- The potential of using insectivorous bats (Microchiroptera) as a means of insect pest control in agricultural areas – Passed with distinction
- Involved a large scale in-depth survey of the bat diversity in the Tzaneen and Waterpoort areas, Limpopo.
- Understanding and observing the biology and behavior of local bat species.

- Designing and experimenting with artificial bat roosts.

Hons Biodiversity and Conservation

- Research project: Preliminary study of the terrestrial Arthropoda associated with caves of the Cradle of Humankind World Heritage Site – Passed with distinction
- Introduction to Environmental Management
- Herpetology
- Terrestrial and conservation ecology
- Resource management (incl. forestry, fire ecology, animal behavior)
- Practical fieldwork methodology (4X4, boat training and mapping)
- Mammology
- Population genetics and biosystematics
- Philosophy and research methodology: Zoology Nature conservation
- Parasitology
- Molecular evolution

BSc Zoology and Botany

- One-year course in animal diversity and identification
- Six month course in basic and marine ecology
- Limnology and terrestrial ecology
- Coastal diversity excursion (Marine ecology)
- Introduction to SASS Freshwater pollution monitoring methodology
- Applied freshwater ecotoxicology
- Waterborne diseases
- Integrated animal physiology and processes
- General parasitology
- Cytology
- Six-month course in the identification and diversity of South African flora
- Ethno and economical plants
- Biotechnology
- Plant physiology
- Plant pathology
- Cellular and molecular biology
- Introduction to organic and physical chemistry
- General chemistry
- Mineralogy and earth dynamics

Additional:

- ***Experienced report writing skills, sufficient computer skills.***
- ***Proficient in GIS, bioacoustics analysis.***
- ***Snake Identification and Handling Course – Presented by MHB Enviro Developments.***
- ***Multiple training courses in bat related topics - Gauteng and Northern Regions Bat Interest Group (GNoRBIG; 2005-2009).***
- ***Soil Classification and Wetland Delineation Course – Presented by Terrasoil.***
- ***Fall Arrest Level 2 qualification (for working at heights).***
- ***Advanced driving course in 4x4 off-road driving.***

Affiliations to professional bodies and societies

- Pr.Sci.Nat.– SACNASP (Zoological Science; registration number 400169/10)
- Steering committee member of the SABAA (South African Bat Assessment Association).
- Bat Conservation International (BCI)
- Serving on the research committee of the Gauteng and Northern Regions Bat Interest Group (GNoRBIG).
- Serving on the steering committee of the Zoological Society of the University of Johannesburg.

Experience

i. 2008 – Current Founder of Animalia Zoological & Ecological Consultation CC. Animalia has completed more than **300 specialist reports and numerous large scale projects** under the supervision and lead of Werner Marais:

ii. 2008 University of Johannesburg Gauteng

- Sensitivity and biodiversity surveys of five caves in the Cradle of Humankind World Heritage Site (COHWHS) and Pretoria areas.
- Preliminary survey to investigate the correlation between insectivorous bats and prey insects in the Krugersdorp Game Reserve.

iii. 2007, 2008 Limpopo

1. *Bertie van Zyl (Pty) Ltd.(ZZ2 Tomato Farms)*
2. University of Johannesburg Gauteng

Two year project to research the biological pest control method of utilizing insectivorous bats in agriculture. Required to conduct an in-depth study of bat (Microchiroptera) behavior and ecologically important factors.

iv. 2006 University of Johannesburg Gauteng

Six month survey of cave dwelling arthropods in the Cradle of Humankind World Heritage Site.

Additional:

Invited by the EWT (Endangered Wildlife Trust) to deliver a presentation on current ecological issues regarding bats and wind energy.

Invited to present on current ecological issues regarding bats and wind energy for ESSA (Exploration Society of Southern Africa).

Contributing editor for the: "South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments – Pre-construction; 3rd Edition February 2014"

As a co-author, recieved the Dow Greeff price for best annual scientific publication: "Die karst-ekologie van die Bakwenagrot (Gauteng)" published in the Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie, Vol. 31(1), 2012.

Public and educational presentations related to bats, and presented a part of a Bat Training Course at Nylsvley Nature Reserve.

Presented the following papers at conferences:

- ***The potential of using insectivorous bats (Microchiroptera) as a means of insect pest control in agricultural areas. The Zoological Society of Southern Africa's 50th Anniversary Conference. July 2009.***
- ***Inseketende vlermuise (Microchiroptera) en vlermuishuise in landbougebiede. Suid Afrikaanse Akademie vir Wetenskap en Kuns se 100 jaar Eufees kongres. October 2009.***

Interviewed for two popular magazine articles on ecological aspects of biological pest control utilising bats; published in two consecutive issues of Farmers Weekly.

Languages

Afrikaans / English – Full professional proficiency in both.

References

Dr Francois Durand – Karst ecologist and paleontologist. Pr.Sci.Nat. (Zoology and Earth Sciences).

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University of Pretoria,
Department of Microbiology and Plant Pathology,
Faculty of Natural and Agricultural Sciences,
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0001

Dr David Hoare (Pr.Sci.Nat.) – David Hoare Consulting CC

083 284 5111
(012) 804 2281
dbhoare@iburst.co.za

Stephan du Toit (MSc; Pr.Sci.Nat.) – Specialist: Environmental Protection; Mogale City Municipality

083 306 3441
stephant@mogalecity.gov.za

Julio Balona – Chairman of the GNoRBIG

082 359 1295
Julio.Balona@lurgi.com

Thank You

CURRICULUM VITAE – DR BRETT WILLIAMS

Name of organisation: Safetech
Profession: Registered Occupational Hygienist / HSE Specialist
Position in Firm: Owner
Date of Birth: 21/04/1963
Years with Firm: 25

BIOGRAPHICAL SKETCH

Dr Brett Williams has been a Health Safety and Environmental Management practitioner since *1987*. Safetech have offices in Pretoria and Port Elizabeth. He has consulted too many different industries including pharmaceutical, mining, oil and gas, chemical, automotive, food production, power utilities etc. He is registered with the Department of Labour and Chamber of Mines to measure environmental stressors, which include chemical monitoring, asbestos, noise and other physical stresses. He has also been trained by the United States Environmental Protection Agency on air pollution measurement and dispersion modelling.

He is a longstanding member of TC 207 and TC 283 at the South African Bureau of Standards for the development of Health & Safety Management Systems as well as Environmental Management Systems. He has thus worked on the development of both the ISO14001:2015 version and the ISO 45001:2018 version. He has assisted many companies in their certification to OHSAS 18001 and ISO 14001 and audited at over 135 companies. He holds a current Private Pilot Licence.

He has also worked in the off-shore oil and gas industry in South Africa, Angola and Nigeria.

TERTIARY EDUCATION

- PhD (Pretoria) – Environmental Management.
- National Diploma Health & Safety Management
- Bachelor of Arts (UPE)
- Master of Business Administration (University of Wales) with dissertation on HSE reporting in South Africa.
- Harvard University – School of Public Health – Advanced Occupational Hygiene Principles
- United States EPA Pollution Measurement course conducted at the University Of Cincinnati (EPA Training Centre)
- US EPA Air Dispersion Modelling Training Course
- Various Health & Safety Courses.
- Environmental Auditor (ISO 14001)
- Health & Safety Auditor (ISO 45001 and OHSAS 18001)

PROFESSIONAL SOCIETIES/ APPROVALS

- Department of Labour - Approved Inspection Authority
- South African Institute Of Safety Management
- Southern Africa Institute of Occupational Hygienists
- Member Technical Committee TC 177 at the SABS for Health & Safety Management Systems.
- Member National Clean Air Association
- Member of Mine Ventilation Society

KEY EXPERIENCE

1. Consultant with National Occupational Safety Association (NOSA) from1987 – 1991.
2. Implementation of OHSAS 18001 & ISO 14001.
3. External Auditor for TUV (Sud) on ISO 14001 and OHSAS 18001 systems.
4. Lecturing to the Safety Management Diploma students at the Port Elizabeth Technikon (OHS Act as well).
5. Participation in the following HSE monitoring:
    - HSE Management System audits and process reviews (including risk assessments)
    - Occupational Hygiene Monitoring
    - Air pollution monitoring and modelling as part of the technical evaluations for environmental impact assessments (ambient and point sources).
    - Noise impact evaluation
    - Waste identification, management and auditing
6. Safety Health & Environmental consulting and examples of experience in the following industries:
    - Electrical Energy Utility – Eskom (Risk Assessments and general HSE consulting for two power generation plants and power distribution systems)
    - Rubber – Goodyear Tyres
    - Vehicle Assembly – BMW, Nissan, Ford, Volkswagen, General Motors
    - Vehicle component manufacture – Dorbyl, Rehau, Faurecia, Armstrong Hydraulics
    - Petrochemical – PetroSA -GTL Plant
    - Oil & Gas – PetroSA - FA Platform, FPSO Xicomba etc
    - Chemical – BASF, Kansai
    - Confectionary – Cadburys
    - Dairy – Parmalat, Woodlands Dairy
    - Aircraft Maintenance – National Airways Corp
    - Local Authority – Nelson Mandela Metro
    - Industrial Gas Manufacture - Afrox
    - Pharmaceutical – Aspen Pharmacare, Winthrop
    - Textile – Industex
    - Construction – Grinaker LTA

References:

Mrs Zelda Lourens, Volkswagen South Africa – 041 -9944549

Mrs Fleur Wilson, Aspen South Africa - 041 - 4072111

Mr Pieter van den Berg, SHEQ Manager, BMW South Africa - 012 - 522 3163

LANGUAGES

Language	Speaking	Reading	Writing
English	Excellent	Excellent	Excellent
Afrikaans	Good	Good	Fair

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe my qualifications, my experience, and me.

Dr Brett Williams

CURRICULUM VITAE

Name: Timothy James Graham Hart

Profession: Archaeologist

Date of Birth: 29/07/60

Parent Firm: ACO Associates cc

Position in Firm: Director

Years with Firm: 11

Years experience: +33 years

Nationality: South African

HDI Status: n/a

Education: Matriculated Rondebosch Boys High, awarded degrees BA (UCT) BA Hons (UCT) MA (UCT).

Professional Qualifications: Principal Investigator ASAPA, member of Association of Heritage Professionals (APHP)

Languages: Fully literate in English, good writing skills. Conversation in Afrikaans, mediocre writing skills, good reading skills.

KEY QUALIFICATIONS

- Bachelor of Arts in Archaeology and Psychology
- BA Honours in Archaeology
- MA in Archaeology
- Recipient of Frank Schweitzer Memorial Prize (UCT) for student excellence
- Professional member (no 50) Association of Southern African Professional Archaeologists (ASAPA)
- Principal Investigator, cultural resources management section (ASAPA)
- Professional member in specialist and generalist categories Association of Heritage Professionals (APHP)
- Committee Member Heritage Western Cape, Committee Member SAHRA
- Awarded Department of Arts and Culture and Sport award (joint recipient) for ***best heritage study in 2014,***

SELECTED PROJECTS

- Excavation, conservation and museum creation: Battery Chavonnes, V&A Waterfront, Cape Town
- Excavation and conservation – Amsterdam Battery, V&A Waterfront, Cape Town
- Excavation and conservation – Sea Point Battery, Sea Point, Cape Town
- Excavation and grave location, museum creation – Prestwich Place, Cape Town
- Conservation plan for East Fort, Table Mountain National Park, Hout Bay, Cape Town, SANParks
- Archaeological survey of Bordjiesrif and Buffels Bay, Table Mountain National Park, Cape Town, SANParks
- Assessment and conservation plan – Ratel Rivier, Agulhas National Park, SANParks
- Specialist consultant – Eskom's Nuclear 1 programme, Eastern, Western and Northern Cape
- Specialist consultant – Eskom's PBMR programme
- Specialist consultant – Department of Water Affairs, raising of Clanwilliam Dam project, Western Cape
- Specialist consultant to De Beers Namaqualand Mines (multiple projects since 1995)
- Specialist consultant – Saldanha Ore Handling Facility phase 2 upgrade

- Three years of involvement in Late Stone Age projects in the Central Great Karoo
- Wind Energy systems: Koekenaap, Hopefield, Darling, Vredendal, Bedford, Sutherland, Caledon (some 75) completed to date.
- Karoo uranium prospecting, various sites
- HIA Houses of Parliament, Cape Town
- Proposed Sunbird Ibhubesi gas project, West Coast of South Africa.
- 1991 – 1997 Annual surveys and mitigation work, De Beers Namakwaland Mines Division.

EXPERIENCE

After graduating from UCT with my honours degree I joined the Southern Methodist University (SMU Dallas Texas) team undertaking Stone Age research in the Great Karoo. After working in the field for a year I registered for a Masters degree in pre-colonial archaeology with support from SMU. On completion of this degree in 1987 I commenced working for the ACO when it was based at UCT. This was the first unit of its kind in RSA.

In 1991 I took over management of the unit with David Halkett. We nursed the office through new legislation and were involved in setting up the professional association and assisting SAHRA with compiling regulations. The office developed a reputation for excellence in field skills with the result that ACO was contracted to provide field services for a number of research organisations, both local and international. Since 1987 in professional practise I have has been involved in a wide range of heritage related projects ranging from excavation of fossil and Stone Age sites to the conservation of historic buildings, places and industrial structures. To date the ACO Associates CC (of which I am co-director) has completed more than 3000 projects throughout the country ranging from minor assessments to participating as a specialist in a number of substantial EIA's as well as international research projects. Some of these projects are of more than 4 years duration.

Together with my colleague Dave Halkett I have been involved in heritage policy development, development of the CRM profession, the establishment of 2 professional bodies and development of professional practice standards. Notable projects I have been involved with are the development of a heritage management plan and ongoing annual mitigation for the De Beers Namaqualand Mines Division, heritage management for Namakwa Sands and other west coast and Northern Cape mining firms. Locally, I was responsible for the discovery of the "Battery Chavonnes" at the V&A Waterfront (now a conserved as a museum and exhibition centre), the discovery of a massive paupers burial ground in Green Point (now with museum and memorial), the fossil deposit which is now the subject of a public display at the West Coast Fossil Park National Heritage Site as well as participating in the development of the Robben Island Museum World Heritage Site. ACO also recently did the archaeology informing the Battery Part project at the V&A and exposed the rare disappearing gun in Sea Point (http://www.bbc.com/travel/gallery/20190423-the-mystery-of-cape-towns-disappearing-gun?ocid=ww.social.link.twitter) I have teaching experience within a university setting and have given many public lectures on archaeology and general heritage related matters. I ran a NLF funded project (R1.2m) to research the historic burial grounds of Green Point which culminated in the publication of a publically well-received book.

Academic Publications

Cruz-Uribe, K., Klein, R.G., Avery, G., Avery, D.M., Halkett, D., Hart, T., Milo, R.G., Sampson, C.G. & Volman, T.P. 2003. Excavation of buried late Acheulean (mid-quaternary) land surfaces at Duinefontein 2, Western Cape Province, South Africa. Journal of Archaeological Science 30.

Dewar, G., Halkett, D., Hart, T., Orton, J. & Sealy, J. 2006. Implications of a mass kill site of springbok (Antidorcas marsupialis) in South Africa: hunting practices, gender relations, and sharing in the Later Stone Age. Journal of Archaeological Science 33 (9), 1266-127.

Finnegan, E., Hart, T. & Halkett, D. 2011. The informal burial ground at Prestwich Street, Cape Town: Cultural and chronological indicators for the informal Cape underclass. The South African Archaeological Bulletin Vol. 66 No. 194 (December 2011), 136-148.

Halkett, D., Hart, T., Yates, R., Volman, T.P., Parkington, J.E., Orton, J., Klein, R.G., Cruz-Uribe, K. & Avery, G. 2003. First excavation of intact Middle Stone Age layers at Ysterfontein, Western Cape Province, South Africa: implications for Middle Stone Age ecology. Journal of Archaeological Science 30 (2003) 955–971.

Hart, T. 1987. Porterville survey. In Parkington, J. & Hall, M.J. eds. Papers in the Prehistory of the Western Cape, South Africa. Oxford: BAR International Series 332.

Hart, T. & Halkett, D. 1994. Reports compiled by the Archaeology Contracts Office, University of Cape Town. Crossmend, HARG. University of Cape Town.

Hart, T. & Halkett, D. 1994. The end of a legend? Crossmend, HARG. University of Cape Town.

Hart, T. 2000. The Chavonnes Battery. Aquapolis. Quarterly of the International Center for Cities on Water. 3-4 2000.

Hart, T. 2017. The archaeology of the infirm, Robben Island. University of Leuven. International conference on sense of place, November 2017.

Hine, P., Sealy, J., Halkett, D. & Hart, T. 2010. Antiquity of stone walled fish traps on the Cape Coast of South Africa. The South African Archaeological Bulletin. Vol. 65, No. 191 (June 2010), pp. 35-44.

Klein, R.G., Avery, G., Cruz-Uribe, K., Halkett, D., Hart, T., Milo, R.G. & Volman, T.P. 1999. Duinefontein 2: An Acheulean Site in the Western Cape Province of South Africa. Journal of Human Evolution 37, 153-190.

Klein, R.G., Cruz-Uribe, K., Halkett, D., Hart, T. & Parkington, J.E. 1999. Paleoenvironmental and human behavioral implications of the Boegoeberg 1 late Pleistocene hyena den, Northern Cape Province, South Africa. Quaternary Research 52, 393-403.

Malan, A., Halkett, D., Hart, T. & Schietecatte, L. 2017. Grave Encounters. Archaeology of the burial grounds, Green Point, South Africa. With preface by Professor Carmel Schrire. ISBN: 978-0-620-71752-6

Orton, J., Halkett, D., Hart, T., Patrick, M. & Pheiffer, S. 2015. An unusual pre-colonial burial from Bloubergstrand, South Africa. South African Archaeological Bulletin 70 (201): 106–112.

Orton, J., Hart, T. & Halkett, D. 2005. Shell middens in Namaqualand: two later Stone Age sites at Rooiwalbaai, Northern Cape Province, South Africa. South African Archaeological Bulletin. Volume 60 No 181.

Parkington, J.E., Poggenpoel, C., Halkett, D. & Hart, T. 2004 Initial observations from the Middle Stone Age coastal settlement in the Western Cape In Conard, N. Eds. Settlement dynamics of the Middle Paleolithic and Middle Stone Age. Tubingen: Kerns Verlag.

Plug, I., Bollong, C.A., Hart, T. & Sampson, C.G. 1994. Context and direct dating of pre-European livestock in the Upper Seacow River Valley. Annals of the South African Museum, Cape Town.

Sampson, C.G., Hart, T., Wallsmith, D.L. & Blagg, J.D. 1988. The Ceramic sequence in the upper Sea Cow Valley: Problems and implications. South African Archaeological Bulletin 149: 3-16.

Smith, A., Halkett, D., Hart, T. & Mütti, B. 2001. Spatial patterning, cultural identity and site integrity on open sites: evidence from Bloeddrift 23, a pre-colonial herder camp in the Richtersveld, Northern Cape Province, South Africa. South African Archaeological Bulletin 56 (173&174): 23-33.

Smith, A., Halkett, D., Hart, T. & Mütti, B. 2001. Spatial patterning, cultural identity and site integrity on open sites: evidence from Bloeddrift 23, a pre-colonial herder camp in the Richtersveld, Northern Cape Province, South Africa. South African Archaeological Bulletin 56 (173&174): 23-33.

Combined Curriculum Vitae :

Bernard Oberholzer Landscape Architect + Environmental Planner (BOLA)

Qualifications:
Bachelor of Architecture (UCT 1970), Master of Landscape Architecture (U. of Pennsylvania 1975)

Professional registration/membership:
Professional member of the SA Council for the Landscape Architectural Profession (SACLAP), reg. no. 87018.
Fellow of the Institute of Landscape Architects of South Africa.
B-BBEE Status: Level 4.

Bernard has 40 years experience as a professional landscape architect, specialising in, environmental planning, coastal planning, urban landscape design and visual assessments.

He is currently an independent consultant, and was for 7 years the Convenor of the Master of Landscape Architecture Programme at UCT.

He has presented papers on Visual and Aesthetic Assessment Techniques, and provides specialist services as a reviewer of visual impact studies prepared by other firms.

He is the author of Guideline for Involving Visual and Aesthetic Specialists in EIA Processes, prepared with the CSIR for the Dept. of Environmental and Development Planning, Provincial Government of the Western Cape, 2005.

Bernard has been involved in numerous land use suitability studies and visual assessments for a wide range of projects, and serves as a member of the Stanford Heritage Committee.

Quinton Lawson Architect (qarc)

Qualifications:
Bachelor of Architecture (Univ. of Natal 1977)

Professional registration/membership:
Professional member of the SA Council for the Architectural Profession (SACAP), reg. no. 3686. Member of the Cape Institute for Architecture and SA Institute of Architects.
B-BBEE Status: Level 4.

Quinton has practiced as a professional architect since 1978, specialising in architectural and urban design, environmental design and computer visualisation.

He was one of the founding partners of Meirelles Lawson Architects formed in 1988, initially specialising in economic and sustainable housing. He was a senior partner at MLB Architecture and Urban Design, with specialist expertise in visual modelling and design solutions, and he retired from MLB Architects in 2018.

In the past he has been a visiting lecturer at UCT teaching a post-graduate course on Computer Techniques in Landscape Architecture, including visualisation and visual assessment techniques.

Together with BOLA, Quinton has been involved in numerous visual impact assessments over a number of years, and he recently served a 5 year term on the Impact Assessment Review Committee of Heritage Western Cape.

List of Projects / Expertise :

1. Rietvlei Environmental Visitor Centre: Visual Impact Assessment, for CSIR and Blaauberg Municipality, 1998. (MLB & BOLA)
2. Proposed Hotel Developments at Spier: Visual Impact Assessment, for Spier Management (Pty) Ltd. 1999. (MLB & BOLA)
3. Portnet Iron-ore Harbour Extensions, Saldanha: Visual and Scenic Impact Assessment, prepared for SRK Consulting, 2000. (MLB & BOLA)
4. Zeconi Optic-fibre Plant at Capricorn Park: Visual and Scenic Impact Assessment, prepared for SRK Consulting, 2001. (MLB & BOLA)
5. Proposed Wind Farm near Darling, Western Cape: Visual Impact Assessment, for Environmental Evaluation Unit UCT, 2001 (MLB & BOLA)
6. Pechiney Aluminium Smelter, Coega, Port Elizabeth: Visual Impact Assessment prepared for CSIR, 2002. (MLB & BOLA)
7. FiberCore Optic Fibre Plant, Somerset West: Visual Impact Assessment, prepared for SRK Consulting, 2002. (MLB & BOLA)
8. Port of Cape Town Container Terminal: Visual Impact Assessment, prepared for CSIR, 2002. (MLB & BOLA)
9. Proposed Fisantekraal Wastewater Treatment Works and Pipeline: Visual Impact Assessment, for SRK and City of Cape Town, 2003. (MLB & BOLA)
10. Proposed Closed Cycle Gas Turbine Power Plant at Oranjemund, Namibia: Visual Impact Assessment, prepared for CSIR and NamPower, 2004. (MLB & BOLA)
11. Proposed Regional Waste Site in Kalbaskraal / Atlantis area: Visual Impact Assessment for CCA Environmental and City of Cape Town, 2005. (MLB & BOLA)
12. Proposed Madiba Bay Leisure Park, Port Elizabeth: Visual Impact Assessment for Coastal Environmental Services and the Madiba Bay Municipality, 2005. (MLB & BOLA)
13. Proposed Boschendal Founders Estate: Visual Impact Assessment for Winter and Baumann, on behalf of Boschendal Estates, 2005. (MLB & BOLA)
14. Proposed Gateway Precinct Developments at the Victoria and Alfred Waterfront: Visual Impact Assessment for GAPP Architects and the V&AW Co. 2006. (MLB)
15. Proposed Normandy Farm Residential Development, Stellenbosch: Visual Baseline Study for CCA Environmental, 2009. (MLB & BOLA)
16. Proposed Residential and Commercial Development, Phase 2, Boschendal: Visual Baseline Study and Visual Impact Assessment for Winter and Baumann on behalf of Boschendal Estates, 2009. (MLB & BOLA)
17. Proposed Solar Power Plant near Touwsrivier: Visual Scoping Report and Visual Impact Assessment for the EEU (UCT), on behalf of Concentrix Solar, 2010. (MLB & BOLA)
18. Proposed Renewable Energy Facilities in the Western and Northern Cape: Visual Baseline Study and Visual Impact Assessment for ERM (Cape Town), on behalf of Mainstream SA, 2010. (MLB & BOLA).
19. Proposed Wind Energy Facilities in the Western and Northern Cape by G7 Renewable Energies: for ERM Southern Africa, 2010. (MLB & BOLA).
20. Proposed Solar Power Farms in the Northern Cape and Free State: Visual impact assessment for ERM Southern Africa, on behalf of Intikon Energy, 2010. (MLB & BOLA).
21. Proposed Wind Farm at Kerrie Fontein, near Darling: Visual baseline and visual impact assessment for Environmental Evaluation Unit, UCT, on behalf of the Oelsner Group, 2011. (MLB & BOLA).
22. Proposed Photovoltaic Power Plants at De Aar and Skeifontein, Northern Cape: Visual baseline studies, for CCA Environmental (Pty) Ltd on behalf of RVA. (MLB & BOLA).
23. Proposed Solar Power Farms in the Northern Cape and Eastern Cape: Visual Impact Assessment for ERM Southern Africa, on behalf of Solaire Direct, 2012. (MLB & BOLA).
24. Proposed Eco-village Development at Hoek van de Berg, Hermanus: Visual Impact Assessment for PHS Consulting, 2012. (MLB & BOLA)

25. Proposed Road Development Programme: Visual Impact Assessment for CCA Environmental, on behalf of the Roads Development Agency, Mauritius, 2013. (MLB & BOLA).

26. Proposed Shell Filling Station Parklands, Western Cape. Visual Impact Assessment for ERM Southern Africa PTY Ltd, on behalf of Shell SA Marketing PTY Ltd., 2013. (MLB & BOLA)

27. Proposed Upgrade of Electrical Infrastructure: Goedverwacht Mission Village, near Piketberg. Visual Impact Assessment for SiVest Environmental, on behalf of Eskom Holdings SOC LTD, 2013. (MLB & BOLA).

28. Strategic Environmental Assessment of the Klapmuts N1 Precinct, for the Drakenstein Municipality, Western Cape, for SiVest Environmental, 2013. (MLB & BOLA).

29. Proposed Extension of the Breakwater Dolos Revetment Across Granger Bay, Reclamation of Land in the Sea and Associated Mixed Use Development within the Granger Bay Precinct, V&A Waterfront, Cape Town. Visual Baseline Study for Khula Environmental Consultants, on behalf of V&A Waterfront Holdings PTY Ltd, 2013. (MLB & BOLA).

30. Proposed Eskom Kwaggaskloof-Hammanshof 66kV Powerline Re-Build and Dismantling of Old Powerline, Visual Impact Assessment for SiVest Environmental, on behalf of Eskom Holdings SOC LTD, 2013. (MLB & BOLA).

31. Proposed Abengoa Phase II Concentrated Solar Power Plant near Upington, Visual Impact Assessment for Savannah Environmental, on behalf of Abengoa Solar Power PTY Ltd, 2013.(MLB & BOLA).

32. Proposed Wind Energy Facility near Murraysburg, Western Cape. Visual baseline study prepared for Arcus. 2014. (BOLA and MLB).

33. Proposed Eskom Longdown Substation, Theewaterskloof, Western Cape. Visual impact assessment prepared for SiVest on behalf of Eskom Distribution. 2014. (BOLA and MLB).

34. National Wind and Solar PV SEA: Landscape Assessment, for the CSIR on behalf of the Dept. of Environmental Affairs, to identify areas best suited for the rollout of wind and solar PV energy projects based on visual/scenic resources within 8 focus areas of South Africa. 2014. (MLB and BOLA).

35. National Electricity Grid Infrastructure SEA: Visual Assessment for the CSIR on behalf of Eskom and the Dept. of Environmental Affairs, to identify suitable corridors for future transmission lines. The visual specialist study focused on scenic and heritage resources, and related visual sensitivity within 5 selected corridors across the country. 2015. (MLB and BOLA).

36. Proposed Ibhubesi Gas Pipeline and Gas Receiving Facility, West Coast. Visual impact assessment prepared for CCA Environmental. 2015.

37. Proposed Wind Energy Facility, Komsberg, Western Cape. Visual baseline study prepared for Arcus Consulting Services. 2015. (BOLA and MLB).

38. SEA for Shale Gas Development in South Africa. Chapter 14 : Visual, Aesthetic and Scenic Resources for the CSIR and DEA. (Contributing Author). 2015. (BOLA and MLB).

39. Proposed Residential and Commercial Development, Boschendal Estate: Visual Baseline Study and Visual Impact Assessment for Winter and Baumann on behalf of Boschendal Estates, 2015. (MLB & BOLA).

40. Proposed Paulputs 200MW CSP and PV Facility near Pofadder, Northern Cape. Visual Baseline Study for Savannah Environmental on behalf of Abengoa Solar Power SA PTY Ltd. 2015. (BOLA and MLB).

41. Proposed Developments on Erven 3025 and 9795, Constantia Uitsig Farm, Constantia Valley. Visual Baseline and Visual Impact Assessment for Henry Aikman, Heritage Practitioner, on behalf of Meerenhof Properties PTY Ltd. 2015. (MLB & BOLA).

42. Proposed Development of Aquaculture Facility, Paternoster, Western Cape. Visual Impact Assessment for Anchor Environmental Consultants. 2015. (MLB & BOLA).

43. Proposed Bon Espirange Substation and 132kV Power Line for the authorised Roggeveld WEF, Western Cape. Visual Impact Assessment prepared for Savannah Environmental on behalf of Roggeveld Wind Power. 2016. (BOLA and MLB).

44. Proposed Phezukomoya and Sankraal Wind Energy Facilities near Noupoort, Northern and Eastern Cape Provinces. Visual Baseline and Visual Impact Assessments for Arcus Consulting Services on behalf of Innowind PTY Ltd. 2016. (BOLA and MLB).

45. Proposed Karee and Kolkies Wind Energy Facilities and associated Grid Connections near Touwsrivier, Western Cape. Visual Baseline and Visual Impact Assessments for Arcus Consulting

Services on behalf of Mainstream Renewable Power Developments PTY Ltd. 2016. (BOLA and MLB).

46. Square Kilometre Array Phase 1 South Africa near Carnarvon, Northern Cape. SEA Specialist Report : Visual and Landscape Assessment for the CSIR (Environmental Management Services). 2016. (BOLA and MLB).

47. Proposed Lamloch Game Farm Developments near Kleinmond, Visual Impact Assessment prepared for Doug Jeffery Environmental Consultants. 2016. (MLB and BOLA).

48. Winery Road Mixed Use SDF near Somerset West - Raithby, Western Cape. Visual Baseline Study, prepared for MLH Architects and Planners on behalf of Milnerton Estates. 2016. (MLB and BOLA).

49. Proposed Sand Mine on Erf 560, Schaap Kraal, Philippi : Visual Assessment prepared for ASHA Consulting and Klipberg Consulting on behalf of NV Donadio. 2017 (MLB and BOLA).

50. SEA for Aquaculture Development in South Africa, Spatial Analysis, Visual Aesthetics and Scenic Resources Chapter prepared for the CSIR and the DEA. 2017 (MLB and BOLA).

51. Proposed Expansion of Harkerville Sand Quarry near Knysna : Visual Assessment prepared for Klipberg Consulting on behalf of Shelfcorp 63. 2017 (MLB and BOLA).

52. Proposed Impofu Wind Energy Faclities and Grid Connections near Oyster Bay, Eastern Cape : Visual Baseline, Scoping and Visual Impact Assessments prepared for Aurecon South Africa for Red Cap PTY LTD. 2017 (MLB and BOLA).

53. Proposed Highlands Wind Energy Facilities and Grid Connections, Eastern Cape: Visual Baseline, Scoping and Visual Impact Assessment prepared for Arcus Consultancy Services for WKN Windcurrent South Africa PTY LTD. 2017 (MLB and BOLA).

54. Proposed Kap Vley Wind Energy Facility and Grid Connection near Kleinzee, Northern Cape. Basic Assessment and Visual Impact Assessment prepared for the CSIR (Environmental Management Services) for JUWI Renewable Energies PTY LTD. 2017 (MLB and BOLA).

55. Proposed Namies Wind Energy Facility and Grid Connection near Aggenys, Northern Cape : Amendment to Visual Impact Assessment prepared for Aurecon South Africa for JUWI Renewable Energies PTY LTD. 2018 (MLB and BOLA).

56. National Electricity Grid Infrastructure SEA Visual Specialist Report Assessment of Additional Corridors prepared for the CSIR (Environmental Management Services). 2018 (MLB and BOLA).

57. Proposed Nitida Wine Farm Boutique Hotel, Durbanville, Western Cape : Visual Impact Assessment prepared for Emily Herschell Environmental Assessment Practitioner. 2018 (QARC and BOLA).

58. Proposed Expansion of I&J Abalone Farm and Processing Facility at Danger Point near Gansbaai, Western Cape : Visual Impact Assessment prepared for SLR Consulting on behalf of I&J Limited. 2018 (BOLA and QARC).

59. Proposed Perdekraal West Wind Energy Facility near Touwsrivier, Western Cape : Amendment Report to Visual Impact Assessment prepared for Savannah Environmental on behalf of BioTherm. 2018 (BOLA and QARC).

60. Proposed Witberg Wind Energy Facility near Matjiesfontein, Western Cape : Amendment Report to Visual Impact Assessment prepared for Savannah Environmental on behalf of Witberg Wind Power PTY LTD. 2018 (BOLA and QARC).

61. Proposed Paulputs Solar PV Energy Facility near Pofadder, Northern Cape : Visual Impact Assessment prepared for GAEA Enviro PTY LTD for JUWI Renewable Energies PTY LTD. 2018 (BOLA and QARC).

62. Proposed Lamloch Game Farm Amended Developments near Kleinmond, Visual Impact Assessment prepared for Doug Jeffery Environmental Consultants. 2018. (BOLA and QARC).

63. Proposed Banna ba Pifhu Wind Energy Facility near Humansdorp, Eastern Cape : Amendment Report to Visual Impact Assessment prepared for Arcus Consulting on behalf of WKN Windcurrent South Africa PTY LTD. 2018 (BOLA and QARC).

64. National Wind and Solar PV SEA: **Phase 2** Landscape Assessment, for the CSIR on behalf of the Dept. of Environmental Affairs, to identify areas best suited for the rollout of wind and solar PV energy projects based on visual/scenic resources. 2018. (BOLA and QARC).

Dr Neville Bews & Associates
SOCIAL IMPACT ASSESSORS

Curriculum Vitae Neville Bews

Dr. Neville Bews & Associates – Johannesburg, South Africa

EDUCATION

- *B.A. (Soc), University of South Africa, 1980*
- *B.A. (Soc) (Hons), University of South Africa, 1984*
- *The Henley Post Graduate Certificate in Management, Henley Management College, United Kingdom*
- *M.A. (Cum Laude), Rand Afrikaans University, 1999*
- *D. Litt. et Phil., Rand Afrikaans University, 2000*

Dr Neville Bews is a senior social scientist and human resource professional with 38 years' experience. He consults in the fields of Social Impact Assessments and research, and human resource management. He has worked on a number of large infrastructure, mining and water resource projects. He at times lectures on social impact assessment for the Department of Sociology, University of Johannesburg.

EXPERIENCE – EXAMPLES

Water resources and regional planning Social Impact Assessments

Department of Water Affairs and Forestry **South Africa**

Social impact assessment for the Mokolo and Crocodile River (West) Water Augmentation Project for increased and assurance of water supply. Research socio-economic circumstances, data analysis, assessment, authored report.

Mzimvubu Water Project Eastern Cape. Research socio-economic circumstances, data analysis, assessment, authored report. Umkhomazi Water Project Phase 1 – Raw Water Component Smithfield Dam - 14/12/16/3/3/3/94; Water Conveyance Infrastructure - 14/12/16/3/3/3/94/1; Balancing Dam - 14/12/16/3/3/3/94/2.

Umkhomazi Water Project Phases 1 – Raw Water Components
Smithfield Dam – 14/12/16/3/3/3/94/
Water Conveyance Infrastructure – 14/12/16/3/3/3/94/1
Balancing Dam – 14/12/16/3/3/3/94/2

Umkhomazi Water Project Phases 2 – Potable Water Component – 14/12/16/3/3/3/95.

The Aveng (Africa) Group Limited (Grinaker LTA) **South Africa**
Assisting the construction company with the social management of the Mokolo and Crocodile River (West) Water Augmentation Project. Consult and mediate between contractors and affected parties advise on strategies to reduce tensions between contractors and the public.

Sedibeng District Municipality **South Africa**
Social impact assessment for the Environmental Management Plan for the Sedibeng District, on behalf of Felehetsa Environmental (Pty) Ltd. Research socio-economic circumstances, data analysis, assessment, authored report.

Felehetsa Environmental (Pty) Ltd **South Africa**
Social Impact Assessment for Waterfall Wedge housing and business development situated in Midrand Gauteng. Research socio-economic circumstances, data analysis, assessment, authored report.

NEMAI Consulting Environmental & Social Consultants **South Africa**
Ncwabeni: Off-Channel Storage Dam, KwaZulu-Natal. Research socio-economic circumstances, data analysis, assessment, authored report.

Social Assessments for mining clients

Vale **Mozambique**
Socio-economic impact assessment of proposed Moatize power plant, Tete. Research socio-economic circumstances, data analysis, assessment, authored report.

Exxaro Resources Limited **South Africa**
Social impact assessment for the social and labour plan for Leeuwpan Coal Mine, Delmas. Research socio-economic circumstances, data analysis, assessment, authored report.

Social impact assessment for the social and labour plan for Glen Douglas Dolomite Mine, Henley-on-Klip. Research socio-economic circumstances, data analysis, assessment, authored report.

Social impact assessment for the social and labour plan for Grootegeluk Open Cast Coal Mine, Lephalale. Research socio-economic circumstances, data analysis, assessment, authored report.

Social and labour plan for the Paardekraal Project, Belfast. Research socio-economic circumstances, data analysis, assessment, authored report.

Social impact assessment for the Paardekraal Belfast Project Belfast. Research socio-economic circumstances, data analysis, assessment, authored report.

Kumba Resources Ltd **South Africa**

Social Impact Assessments for the Sishen Iron Ore Mine in Kathu Northern Cape. Research socio-economic circumstances, data analysis, assessment, authored report.

Social Impact Assessments for the Sishen South Project in Postmasburg, Northern Cape. Research socio-economic circumstances, data analysis, assessment, authored report.

Social Impact Assessments for the Dingleton resettlement project at Sishen Iron Ore Mine Kathu, Northern Cape. Research socio-economic circumstances, data analysis, assessment, authored report.

Gold Fields **South Africa**

Social Impact Assessment for the Gold Fields West Wits Project. Research socio-economic circumstances, data analysis, assessment, authored report.

Anglo Coal **South Africa**

Review of social impact assessment for the proposed Waterberg Gas 37-spot coalbed methane (CBM) bulk yield test project.

Sekoko Mining **South Africa**

Sekoko Wayland Iron Ore, Molemole Local Municipalities in Limpopo Province. Research socio-economic circumstances, data analysis, assessment, authored report.

Memor Mining (Pty) Ltd **South Africa**

Langpan Chrome Mine, Thabazimbi, Limpopo. Research socio-economic circumstances, data analysis, assessment, authored report.

Prescali Environmental Consultants (Pty) Ltd **South Africa**

Vlakpoort Open Cast Mine – Thabazimbi, Limpopo. Research socio-economic circumstances, data analysis, assessment, authored report.

Afrimat Ltd **South Africa**

1. Marble Hall Lime Burning Project: Social Impact Assessment – Limpopo.
2. Glen Douglas Lime Burning Project: Social Impact Assessment - Henley-on Klip, Midvaal

Social assessments for regional and linear projects

Gautrans **South Africa**

Social impact for the Gautrain Rapid Rail Link, Pretoria to Johannesburg and Kempton Park. Managed a team of 10 field workers, research socio-economic circumstances, data analysis, assessment, and co-authored report.

South African National Road Agency Limited **South Africa**

Social Impact of tolling the Gauteng Freeway Improvement Project. Research socio-economic circumstances, data analysis, assessment, authored report.

Social Impact of the N2 Wild Coast Toll Highway. Managed a team of three specialists. Research socio-economic circumstances, data analysis, assessment, co-authored report.

SIA for the N3 Keeversfontein to Warden (De Beers Pass Section). Research socio-economic circumstances, data analysis, assessment, authored report.

Transnet **South Africa**

Social impact assessment for the Transnet New Multi-Product Pipeline Project (555 km) (Commercial Farmers). Research socio-economic circumstances, data analysis, assessment, authored report.

Expansion of Railway Loops at Arthursview; Paul; Phokeng and Rooiheuwel Sidings in the Bojanala Platinum District Municipality in the North West Province for Transnet Soc Ltd.

Eskom Holdings Limited **South Africa**

Social Impact Assessment for the Ubertas 88/11kV Substation in Sandton, Johannesburg. Research socio-economic circumstances, data analysis, assessment, authored report.

Nuclear 1 Power Plant. Assisted with the social impact assessment consulting to Arcus GIBB Engineering & Science. Peer review and adjusted the report and assisted at the public participation feedback meetings.

Social impact assessment for Eskom Holdings Limited, Transmission Division's Neptune-Poseidon 400kV Power Line in the Eastern Cape. Research socio-economic circumstances, data analysis, assessment, authored report.

Social Impact assessment for Eskom Holdings Limited, Transmission Division, Forskor-Mernsky 275kV±130km Powerline and Associated Substation Works in Limpopo Province. Research socio-economic circumstances, data analysis, assessment, authored report.

Eskom Holdings Limited, Transmission Division **South Africa**

Social Impact assessment for Eskom Holdings Limited, Transmission Division, Tubatse Strengthening Phase 1 – Senakangwedi B Integration in Limpopo Province. Research socio-economic circumstances, data analysis, assessment, authored report.

Basic SIA study for Proposed 1 X 400 kV Eskom Maphutha - Witkop 170 km Powerline.

Social Impact Assessment for the Mulalo Main Transmission Substation and Power Line Integration Project, Secunda

MGTD Environmental **South Africa**

Social impact assessment for a 150MW Photovoltaic Power Plant and Associated Infrastructure in Mpumalanga. Research socio-economic circumstances, data analysis, assessment, authored report.

10MWp Photovoltaic Power Plant & Associated Infrastructure, North West Province. Research socio-economic circumstances, data analysis, assessment, authored report.

eThekwini Municipality **South Africa**

Social impact assessment for the proposed infilling of the Model Yacht Pond at Blue Lagoon, Stiebel Place, Durban. Research socio-economic circumstances, data analysis, assessment, authored report.

Kennedy Road Housing Project, Ward 25 situated on 316 Kennedy Road, Clare Hills (Erf 301, Portion 5).

Afzelia Environmental Consultants and Environmental Planning & Design **South Africa**

Proposed Cato Ridge Crematorium In Kwazulu-Natal Province

MGTD Environmental **South Africa**

ABC Prieska Solar Project; Proposed 75 MWp Photovoltaic Power Plant and its associated infrastructure on a portion of the remaining extent of ERF 1 Prieska, Northern Cape. Research socio-economic circumstances, data analysis, assessment, authored report.

ABC Prieska Solar Project; Proposed 75 MWp Photovoltaic Power Plant and its associated infrastructure on a portion of the remaining extent of ERF 1 Prieska, Northern Cape.

Assessments for social projects and social research

Australia – Africa 2006 Sport Development Program **South Africa**

To establish and assess the impact of the Active Community Clubs Initiative on the communities of NU2 (in the township of Mdantsane)*and Tshabo (a rural village). Lead researcher social, data collection and analysis, assessment.

United Nations Office on Drugs and Crime **South Africa**

Evaluation of a Centre for Violence Against Women in Upington. Research socio-economic circumstances, data analysis, assessment, co-authored report.

University of Johannesburg **South Africa**

Research into research outputs of academics working in the various departments of the university. Research socio-economic circumstances, data analysis, assessment, authored report.

Human Resource and management training

Various national companied **South Africa**

Developed and run various management courses such as, recruitment selection & placement; industrial relations / disciplinary hearings; team building workshops; multiculturalism workshop. 1986-2007

University of South Africa, Department of Industrial Psychology **South Africa**

Developed the performance development study guide for industrial psychology 3. 2000

Authored Chapters in HR books **South Africa**

In Slabbert J.A. de Villiers, A.S. & Parker A (eds.). Managing employment relations in South Africa. Teamwork within the world-class organisation. 2005

In Muchinsky, P. M. Kriek, H. J. & Schreuder, A. M. G. Personnel Psychology 3rd Edition
Chapter 9 – Human resource planning.
Chapter 10 – The changing nature of work. 2005

In Rossouw, G. J. and van Vuuren, L. Business Ethics - Made in Africa 4th Edition.
Chapter 11 – Building Trust with Ethics. 2010

South African Management Development Institute (SAMDI) **Democratic Republic of the Congo**

Developed a course on Strategic Human Resource Planning for SAMDI and the Democratic Republic of the Congo as well as trainer's manuals for this course. 2006.

Competition Tribunal **South Africa**

Developed a Performance Management System and Policy for the Competition Tribunal South Africa. 2006

PUBLICATIONS

Bews, N. & Martins, N. 2002. An evaluation of the facilitators of trustworthiness. SA Journal of Industrial Psychology. 28(4), 14-19.

Bews, N. Martins, N. & von der Ohe, H. 2002. Editorial. SA Journal of Industrial Psychology. 28(4), 1.

Bews, N. & Rossouw, D. 2002. Contemporary organisational change and the importance of trust. SA Journal of Industrial Psychology. 28(4), 2-6.

Bews, N. & Uys, T. 2002. The impact of organisational restructuring on perceptions of trustworthiness. SA Journal of Industrial Psychology. 28(4), 21-28.

Bews, N & Rossouw, D. 2002. A role for business ethics in facilitating trustworthiness. Journal of Business Ethics. 39: 377-390.

Bews, N. 2009. A matter of trust – Gaining the confidence of the public and client. IAIA Newsletter Forthcoming (Spring 2009).

Bews, N. 2009. Does he who pays the bill call the shots? Sitting astride client and public interest – the dilemma of maintaining credibility in impact assessments. IAIA Newsletter Winter – 2009.

Bews, N. 2002. Reducing your company's risk of sexual harassment claims. HR Future. (2) 2 10-11.

Bews, N. & Martins, N. von der Ohe, H. 2002. Organisational change and trust: Experiences here and abroad. Management Today, (18) 8 34-35.

Martins, N. Bews, N. & von der Ohe, H. 2002. Organisational change and trust. Lessons from Europe and South African organisations. HR Future, (2)9 46-47.

Rossouw, D. & Bews, N. 2002. The importance of trust within a changing business environment. Management Today. 18(2) 26-27.

Bews, N. 2001. You can put a value to trust in the new economy. HR Future, (1)1 48-49.

Bews, N. 2001. Maintaining trust during organisational change. Management Today, (17) 2 36-39.

Bews, N. 2001. Business ethics, trust and leadership: how does Africa fare? Management Today, (17) 7 14-15.

Rossouw, D & Bews, N. 2001. Trust is on the decline in the workplace, yet it's vital for modern organisational success. People Dynamics. (18) 6 28-30.

Bews, N. & Uys, T. 2001. The effects of restructuring on organisational trust. HR Future, (1)8 50-52.

Rossouw, G. J. & Bews. N. F. 2010. Building Trust with Ethics. In Rossouw, G. J. and van Vuuren, L. Business Ethics - Made in Africa 4th Edition. Cape Town: Oxford University Press.

Bews N. 2005. Teamwork within the world-class organisation. In Slabbert J.A. de Villiers, A.S. & Parker A (eds.). Managing employment relations in South Africa. Durban : Butterworths.

Bews, N. F. 2005. Human resource planning. In Muchinsky, P. M. Kriek, H. J. & Schreuder, A. M. G. 2005. Personnel Psychology 3rd Edition. Cape Town; Oxford University Press.

Bews, N. F. 2005. The changing nature of work. In Muchinsky, P. M. Kriek, H. J. & Schreuder, A. M. G. 2005. Personnel Psychology 3rd Edition. Cape Town; Oxford University Press.

Bews, N. F. 2005. Chapter 9 & 13. In Muchinsky, P. M. Kriek, H. J. & Schreuder, A. M. G. 2005. Instructor's Manual. Personnel Psychology 3rd Edition. Cape Town; Oxford University Press.

Bews, N. F., Schreuder, A. M. G. & Vosloo, S. E. 2000. Performance Development. Study guide for Industrial Psychology 3. Pretoria: University of South Africa.

Uys, T. and Bews, N. 2003. ''Not in my Backyard'': Challenges in the Social Impact Assessment of the Gautrain. Department of Sociology Seminar, RAU. 23 May 2003.

Bews, N. 2002. The value of trust in the new economy. Industrial Relations Association of South Africa (Irasa). Morning seminar 21 August 2002.

Bews. N, 2002. The issue of trust considered. Knowledge Recourses seminar on Absenteeism. The Gordon Institute of Business. 27 August 2002.

Bews, N. & Uys, T. 2001. The impact of organisational trust on perceptions of trustworthiness. South African Sociological Association Conference. Pretoria.

Bews, N. 2001. Business Trust, Ethics & Leadership:- Made in Africa. International Management Today/Productivity Development Conference. Hosted by Productivity Development (Pty) Ltd & Management Today. Best Knowledge in Leadership Practice Conference 23-24 July 2001.

Bews, N. 2001. Charting new directions in leading organisational culture and climate change. Workplace Transformation and Organisational Renewal. Hosted by The Renaissance Network. November 2001.

Bews, N. 2000. Towards a model for trust. South African Sociological Association Conference. Saldanha.

Bews, N. 2003. 'Social Impact Assessments, theory and practice juxtaposed – Experience from a South African rapid rail project.' New Directions in Impact Assessment for Development: Methods and Practice Conference. University of Manchester, Manchester, England.

MEMBERSHIP OF PROFESSIONAL BODIES

Member of South African Affiliate of the International Association for Impact Assessment (IAIAsa). Membership Number: 2399

Registered on database for scientific peer review of iSimangaliso GEF project outputs

Short CV/Summary of Expertise – Simon Todd

SIMON TODD CONSULTING

ECOLOGICAL SPECIALIST SERVICES

Assessment/Management/Research

Simon Todd Pr.Sci.Nat
C: 082 3326502
O: 021 782 0377
Simon.Todd@3foxes.co.za
60 Forrest Way
Glencairn
7975

Ecological Solutions for People & the Environment

Professional Profile

Simon Todd has extensive experience in biodiversity management and ecological assessment across South African ecosystems. This includes a variety of broad-scale strategic assessments and best-practice guidelines for a range of industries. In addition, Simon Todd has conducted a large amount of research on the impacts of land-use on biodiversity and has published numerous scientific papers in international peer-reviewed journals on this topic. Simon Todd is a recognised ecological expert and is a past chairman and current executive committee member of the Arid-Zone Ecology Forum and has over 20 years' experience working throughout the country. Simon Todd is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Recent notable projects include:

- First-author of a book chapter on the ecological impacts of Shale Gas development on the Karroo of South Africa. (2017)
- Co-author on the Biodiversity chapter of the Shale Gas SEA being conducted by CSIR. (2016)
- Co-author on the Eskom Grid Infrastructure SEA, managed by CSIR. (2016)
- Co-author on the Wind and Solar SEA, managed by CSIR. (2015)

Abbreviated CV

- Profession: Independent Ecological Consultant - Pr.Sci.Nat 400425/11
- Specialisation: Plant & Animal Ecology
- Years of Experience: 20 Years

Skills & Primary Competencies

- Research & description of ecological patterns & processes in Thicket, Savannah Nama Karoo, Succulent Karoo, Arid Grassland and Fynbos Ecosystems.
- Ecological Impacts of land use on biodiversity and provision of associated management advice.

- Vegetation surveys & degradation assessment & mapping
- Long-term vegetation monitoring
- Faunal surveys & assessment.
- GIS & remote sensing

Tertiary Education:

- 1992-1994 – BSc (Botany & Zoology), University of Cape Town
- 1995 – BSc Hons, Cum Laude (Zoology) University of Natal
- 1996-1997- MSc, Cum Laude (Conservation Biology) University of Cape Town

Employment History

- 1997 – 1999 – Research Scientist (Contract) – South African National Biodiversity Institute
- 2000-2004 – Specialist Scientist (Contract) - South African National Biodiversity Institute
- 2004-2007 – Senior Scientist (Contract) – Plant Conservation Unit, Department of Botany, University of Cape Town
- 2007-Present – Senior Scientist (Associate) – Plant Conservation Unit, Department of Botany, University of Cape Town.
- 2010-Present – Self-employed as consultant and sole proprietor of Simon Todd Consulting, which has conducted more than 150 specialist assessments.

General Experience & Expertise

- Lead ecologist on several SEA chapters, including Eskom Grid Infrastructure, Wind and Solar SEA and Shale Gas SEA.
- Conducted a large number of fauna and flora specialist assessments distributed widely across South Africa. Projects have ranged in extent from <50 ha to more than 50 000 ha.
- Widely-recognized ecology specialist. Published numerous peer-reviewed scientific publications based on various ecological studies across the country. Past chairman of the Arid Zone Ecology Forum and current executive committee member.
- Extensive field and personal experience across a broad range of South African ecosystems, with particular focus on the Western, Northern and Eastern Cape.
- Strong research background which has proved invaluable when working on ecologically sensitive and endangered ecosystems, habitats and species.
- Published numerous research reports as well as two book chapters and a large number of papers in leading scientific journals dealing primarily with human impacts on the vegetation and ecology of South African ecosystems.
- Maintain several long-term vegetation monitoring projects which have led to several publications.
- Guest lecturer at two universities and have also served as an external examiner.
- Reviewed papers for more than 12 international ecological journals.
- SACNASP registered as a Professional Natural Scientist, (Ecology) No. 400425/11.

Current Committees

- SANBI Vegmap Committee – 2015 – present
- CSIR Wind and Solar SEA Phase II advisory committee – 2016-present
- AZEF deputy chair – 2012-present
- SANBI Karoo Biogaps Taxon leads' committee and executive committee member.

Recent & Relevant Outputs & Publications

Strategic Environmental Assessments

Co-Author. Chapter 7 - Biodiversity & Ecosystems - Shale Gas SEA. CSIR 2016.
Co-Author. Chapter 1 Scenarios and Activities – Shale Gas SEA. CSIR 2016.
Co-Author – Ecological Chapter – Wind and Solar SEA. CSIR 2014.
Co-Author – Ecological Chapter – Eskom Grid Infrastructure SEA. CSIR 2015.
Contributor – Ecological & Conservation components to SKA SEA. CSIR 2017.

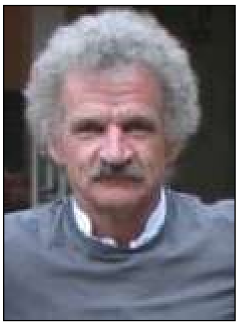
Specialist Fauna and Flora Assessments:

Specialist Ecological studies for many different developments distributed across the country including:

- Over 30 Wind Energy projects
- More than 60 Solar Energy developments
- More than 30 different housing, roads, mining and other infrastructure development projects.
- More than 20 electricity transmission infrastructure projects.

A full list of projects is available on request.

CURRICULUM VITAE



ROBERT EDWARD SIMMONS

B.Sc. (Hons.) 1978, Astronomy & Physics (London)
M.Sc. 1983, Biology (Acadia, Canada)
Ph.D. 1989, Zoology (Witwatersrand, RSA)
Post-doc 1989 and 1994 (Witwatersrand and Uppsala, Sweden)

SYNOPSIS

- Ecologist, conservation biologist and environmental consultant specialising in population ecology, conservation biology and wind/solar farm impacts.
- Research background in UK, Canada and Africa with interests in mating systems, siblicide, latitudinal effects on breeding, and conservation of threatened birds.
- Previously employed as Namibia's State ornithologist and managed Namibia's Biodiversity Programme.
- Currently a Research Associate with FitzPatrick Institute, Centre of Excellence; and Research Fellow, Institute of Zoology, London.
- Supervising students assessing impact of cats on biodiversity and long term research on raptorial and wading birds with NRF funding.
- Consultant in Namibia and South Africa assessing impact of renewable energy industry, power lines and diamond mines on vulnerable birds.
- Academic H-Index 24, i10 index 50 (over 100 citations per year).

PERSONAL DETAILS

Citizenship:	British citizen + South African Permanent Resident
Present address:	c/o FitzPatrick Institute, University of Cape Town, Rondebosch, South Africa, 7701
E-mail:	Rob.simmons@uct.ac.za

ACADEMIC TRAINING

B.Sc. Hons:	Astronomy and Physics, London University	1975-1978
Master's degree:	Biology and Ornithology, Acadia University, Canada	1979-1983
Doctoral degree:	Zoology, Ornithology, University of the Witwatersrand, RSA	1984-1989
Post-doctoral research:	University of the Witwatersrand, Johannesburg, RSA	1988-1989
	Uppsala University, Sweden	1993-1994

ACADEMIC AND PROFESSIONAL EXPERIENCE

Ministry of Environment & Tourism, Namibia, as:

- Wetland biologist (1990-1992);
- State ornithologist (1992-2003).

Honourary Research Associate at the University of Cape Town (2000-present).
Honourary Research Associate at the Institute of Zoology, London

Undertaking research in:
- Long-term assessment of Black Harrier ecology and vulture conservation;
- Impact of domestic cats on biodiversity around Greater Cape Town;
- Evolution and sexual selection of the giraffe
- Climate change research on arid-adapted birds
- Collision-prone birds at wind and solar farms in South Africa and Namibia

- Long-term population assessments of migrant palearctic waders

Research topics explored :

- Long-term regional and Namibian wetland bird counts;
- Case studies of Namib desert coastal wetlands (Sandwich Harbour, Walvis Bay and Cunene River);
- Global population estimates of desert-breeding Damara Terns;
- Climate change effects on breeding of Greater and Lesser flamingos;
- Population estimates of all Namibian endemic birds;
- Effects of the Epupa Dam on Cunene River ecology;
- Blue Crane declines in southern Africa;
- Evolutionary ecology of giraffe;
- Papuan Harrier ecology and conservation;
- IUCN conservation assessments of all Namibian birds;
- Rapid biodiversity assessment of Angola's Iona National Park (with Dr Brian Huntley);
- Interactions between wind farms and Black Harriers.

1. Published work includes:

- Patterns of endemism of plants and vertebrates in Namibia to assess placement of protected areas;
- Assessment of the avifauna of Namibia's perennial rivers;
- Long-term (25-30yr) fluctuations of avian populations at premier coastal wetlands on the desert coast;
- Breeding adaptations of desert-breeding penguins and Damara Terns;
- Namibia's first Red Data Book on threatened birds (publ. 2015).

Within the National Biodiversity Programme, as chair and co-chair of Working Groups on Wetlands and Mountains from 1999-2003, our goal was to increase awareness, research, and understanding of these two threatened ecosystems in Namibia. Book published 1998.

In collaboration with UCT's FitzPatrick Institute staff and students, I research the ecology and conservation of the *Endangered* Black Harrier in South Africa using genetic analysis and satellite tagging. This has spawned 3 theses, 3 published papers, conference presentations and numerous popular articles leading to a better understanding of the conservation needs of the. Black Harrier, now in its 16th year. I also run a blog site: http://blackharrierspace.blogspot.com/2015/01/the-season-for-migration-east.html

CURRENT IMPACT ASSESSMENTS (of 50 completed)

I co-founded Birds & Bats Unlimited, an environmental consultancy company assessing avian impacts at wind and solar farms, diamond mines, power lines and other developments in southern Africa. http://www.birds-and-bats-unlimited.com

Recent EIAs include:

- Impact assessment of birds at a CSP solar site in the Kalahari (Kenhardt);
- Impact assessment of birds at CSP solar site in Ilanga (Northern Cape);
- Impact assessment of collision-prone birds at wind farms in the Karoo (Witberg);
- Impact assessment of collision-prone birds and bats at a wind farm in the Karoo (Tooverberg)
- Impact assessment of birds and bats at wind farms in coastal northern Cape (Kleinsee)

Present Collaborative Research

- Mega transect E-W across Namibia assessing aridity/climate change effects on bird communities (with C. Seymour - SANBI);
- Long-term health and genetic assessment of *Endangered* Black Harriers, particularly between agricultural and protected areas (with S. Garcia-Heras, F. Mougeot, B. Arroyo, J Fuchs);
- Wetland bird population trends in Namibia over last 25-30 years (with B. Erni - UCT Stats Dept);
- Revisiting giraffid evolution (with Profs R. Altwegg and A Chinsamy-Turan - SANBI and UCT);
- Impact of domestic cats on wildlife around Cape Town (with J. O'Riain, UCT).

POST GRADUATE STUDENT RECORD

As an Honourary Research Associate at the University of Cape Town I have supervised 17 students (11 of whom were UCT students): 3 Honours, 8 Masters, 3 PhDs. These students, from all over the world, researched the effects of climate change and renewable energy on vulture populations, Damara tern ecology, domestic cat biodiversity impacts, Kenyan wading birds, pesticides in Kenyan Fish Eagles, the use of harriers as a surrogate for biodiversity value and the first avian sensitivity map for Lesotho.

COLLABORATIVE LINKS WITH SOUTH AFRICAN AND OVERSEAS INSTITUTES

Hosted sabbatical leave and collaborated with:

- Dr Ian Jamieson (Univ Dunedin, NZ), 1998
- Dr Tom Scott (Univ California, Humbolt, USA), 2003
- Dr Andrew Balmford (Cambridge University) 2005
- Professors Brian Huntley and Rhys Green (Univ of Durham and Cambridge/RSPB) 2013-2015
- Drs Bea Arroyo and Francois Mougeot (IREC, Cuidad Real, Spain) 2015-2016

As a research associate with the **Institute of Zoology London**, I have collaborated with Dr Richard Pettifor on clutch size evolution of Cape Wagtails in 2005 in South Africa, and assisted Dr Guy Cowlishaw with implementing his long-term study of baboon ecology in Namibia.

NRF Evaluation: Ranked C1, C2 grade researcher in 2006, 2010 and 2016 evaluations.
NRF Funding: Have been 100% successful with all applications for funding over the last 10 years, to undertake climate change research, cat impacts research and Black Harrier ecology and conservation.
Birdlife South Africa: I was appointed the Black Harrier **Species Guardian** and received funds 2013-2015.

Reviewer for:
- National Geographic Awards (USA);
- WWF (SA);
- IUCN threatened species committee (for CITES committee);
- Whitley Awards (UK);
- National Research Foundation (SA).

Referee for the following scientific journals:
Ambio, American Naturalist, Anatomical Record, Animal Behaviour, Auk, Austral Ecology, Behavioural Ecology & Sociobiology, Behavioral Ecology, Biological Conservation, Biol J. Linneaen Soc, Bird Study, Condor, Hydrobiologia, Ibis, J of Applied Ecol, J of Avian Biology, J of Biodiversity, J of Zoology (London), J of African Raptor Biology, J of Raptor Research, Madoqua, Oecologia, Oikos, Oryx, Ostrich, PlOs1, Scientific Society Namibia, S Af J Science, S Af J Zool, Wilson Bulletin.

Editorial experience

- Associate Editor *Ibis* (2009-2012),
- formerly associate editor for *Ostrich* (15 y)
- Founder, editor, and co-manager of Gabar, a pan-African journal of raptor conservation and research from 1986-1988. (still published 30 years later)
- Principal editor of: *The status and conservation of wetlands in Namibia (*1990)
- Edited Romanian National Biodiversity Strategy and Action Plan (2007)
- Principal author/editor *Birds to Watch in Namibia: red, rare and endemic species* (2015)

Publications and Citations:
2 books, 9 book chapters, 6 Proceedings, 104 peer-reviewed papers, 4 book reviews, 70 popular articles .
H-Index 24, i-10 index 50, (Nov 2016), full information at:
https://scholar.google.com/citations?user=Mjv8zisAAAAJ

Referees

Prof Brian Huntley brian.huntley@durham.ac.uk; Prof Ian Newton ine@ceh.ac.uk
Prof J Midgley jeremy.midgley@uct.ac.za; Dr CL Seymour c.seymour@sanbi.org.za