Cumulative impacts in relation to an activity are defined in the Environmental Impact Assessment Regulations (Government Notice R543) as meaning "the impact of an activity that in it self may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area"

There has been a substantial increase in renewable energy developments (and wind farms in particular) recently in South Africa as legislation is evolving to facilitate the introduction of Independent Power Producers (IPPs) and renewable energy into the electricity generation mix. The focus of the renewable energy developments have largely been in the Northern, Western and Eastern Cape. It has been suggested that there is presently over 6 000 MW of proposed wind energy developments in South Africa[1].

Due to the recent substantial increase in interest in wind farm developments in South Africa, it is important to follow a precautionary approach in accordance with NEMA to ensure that the potential for cumulative impacts are considered and avoided where possible.

It should however be noted that not all the wind farms presently under consideration by various wind farm developers will become operational. It is considered that not all proposed developments will be granted the relevant permits by the relevant authorities (DEA, DOE, NERSA and Eskom) and this is because of the following reasons:

- There are limitations to the capacity of the existing Eskom grid;
- Not all applications will receive positive environmental authorisation;
- There are stringent requirements to be met by applicants;
- Not all proposed wind farms will be viable because of the availability of sufficient wind resource);
- Not all wind farms will be able to reduce negative impacts to acceptable levels or able to mitigate adequately; and
- Not all wind farms will be successful in securing financial support.

The Department of Energy has recently released a request for proposals (RfP) under their renewable energy Independent Power Producer procurement programme (IPP Procurement Programme) to select IPPs. The aim of the programme is to contribute towards the renewable energy target of 3 725 MW (1 850 MW of which allocated to Wind Energy) and to stimulate the industry in South Africa. The bid selection process will consider the suggested tariff as well as socio-economic development opportunities provided by the project and the bidder.

(1) [1] http://www.engineeringnews.co.za/article/6-000-mw-of-wind-power-ready-to-be-commissioned-sawea-2010-07-23

Wind farm developments have effects (positive and negative) on natural resources, the social environment and on the people living in a project area. The preceding impact assessment chapters have assessed the impacts associated with the wind farm at Roggeveld largely in isolation. It is important to, and there is a legislated requirement to, assess cumulative impacts associated with a proposed development. This chapter looks at whether the proposed project's potential impacts become more significant when considered in combination with the other known or proposed wind farm projects within the area.

16.1 APPROACH TAKEN TO ASSESS CUMULATIVE IMPACTS

Significant cumulative impacts that could occur due to the development of wind energy facilities in proximity to each other include impacts such as:

- visual intrusion;
- change in sense of place and character of the area;
- an increase in the significance of avifaunal impacts;
- potential impact on bats;
- loss of vegetation; and
- Temporary traffic impacts during construction.

Clarity on the environmental impact on birds and bats in terms of this and other wind farms proposed for the same area can only be reached once the recommended pre-construction monitoring has been completed across all considered projects and a commitment established for monitoring into the operational phase. The cumulative impact of all the proposed facilities throughout South Africa could have detrimental impacts on birds and bat populations, and directly affect other biodiversity through micro-climatic changes and habitat disturbance. There is a dire need to fill our knowledge gaps and for government to understand the need for informed decision making regarding the approval of numerous applications.

The cumulative impacts of the wind farm and other known wind energy developments, and the in-combination effects of the Roggeveld Wind Farm and other known developments will be qualitatively assessed in this Chapter. *Figure 166.1* shows the proposed location of the Roggeveld Wind Farm in relation to all other known wind farm developments. It is important to note that the location and information available for each proposed wind farm has been taken from the latest (no updated information was available at the time of this report) publically available information from the South African Wind Energy Association (SAWEA) (dated July 2010) and other wind farm developers.

Figure 166.1 Planned renewable energy facilities in the vicinity of Roggeveld

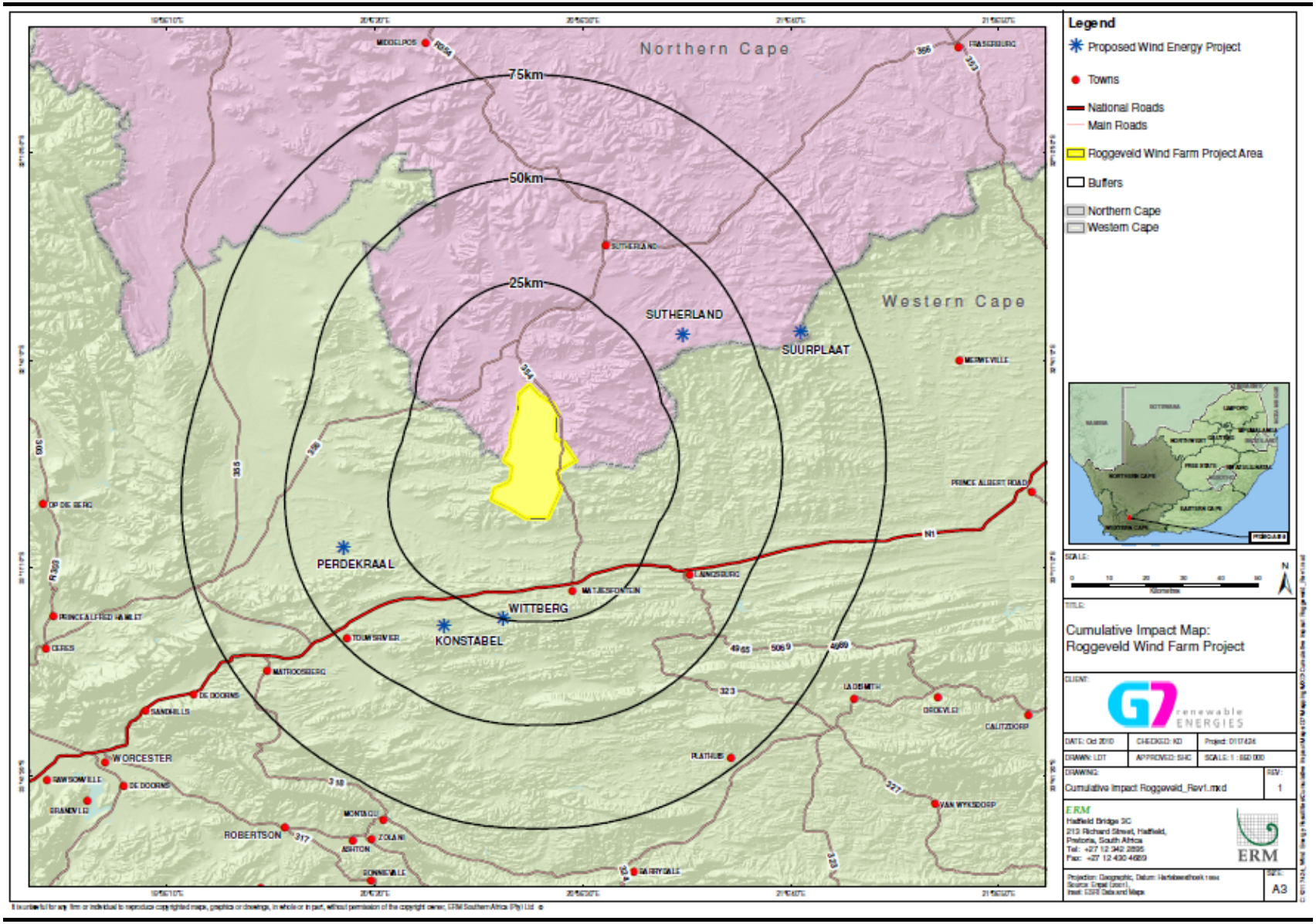

Table 16.1 Planned wind farms in the vicinity of Roggeveld

Wind Farm (Developer)	No. of turbines	Distance (km)	Status of the development
Konstabel Wind Farm (Mainstream SA)	Up to 60	Approximately 30km south of Roggeveld	Final EIR submitted
Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest	Final EIR submitted
Witberg Wind Farm (G7 Renewable Energies)	Up to 250	Approx. 25km south of Roggeveld	Final EIR submitted
Sutherland (Mainstream SA)	293 to 386	Approx 35km north east of Roggeveld	Final EIR submitted
Suurplaat Wind Farm (Windlab and Moyeng)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received

It is evident that Table 166.1
The combined effect of the various wind farms proposed for this area will have a cumulative visual impact and impact on the landscape character. The significance of this cumulative impact is uncertain as at the time the assessment was undertaken the details of the final layouts of Witberg and Konstabel were not available and could thus not be quantitatively assessed. The cumulative visual impact and impact on landscape character resulting from the other known wind farms in the vicinity is also difficult to assess but may be less significant due to the larger distances between the facilities. However, comparing projects with similar production capacities, the ones with fewer turbines or higher wind resources could be considered as having potentially less overall impact than other projects with more turbines.

As there is uncertainty as to whether all the above mentioned developments will be implemented, it is also difficult to quantitatively assess the potential cumulative impacts. It is however important to explore the potential cumulative impacts qualitatively as this will lead to a better understanding of these impacts and the possible mitigation that may be required. The assessment and implementation of mitigatory measures should be lead by Government in collaboration with the renewable energy sector and relevant NGO's. As these cumulative impacts are explored in more detail the trade-offs between promoting renewable energy (and the associated benefits in terms of reduction in CO_2 emissions – a national interest) versus the local and regional environmental and social impacts and benefits (i.e. impacts on bird and bat populations, landscape, tourism, flora, employment etc) will become evident. It is only when these trade-offs are fully understood, that the true benefits of renewable energy can be assessed.

The scale at which the cumulative impacts are assessed is important. For example the significance of the cumulative impact on the regional or national economy will be influence by wind farm developments throughout South Africa, while the significance of the cumulative impact on visual amenity may only be influence by wind farm developments that are in closer proximity to each other say 30 km to 50 km apart. At this stage it is not feasible to look at the wind farm developments at a national scale and for practical purposes a sub-regional scale has been selected.

In the sections below the potential cumulative impacts of several wind farms within a 70 km radius of the proposed Roggeveld Wind Farm are explored. The discussion and associated conclusions must be understood in the context of the uncertainty associated with the proposed developments and the qualitative nature of the assessment.

16.2 CUMULATIVE IMPACT ON FAUNA (EXCLUDING AVIFAUNA AND BATS) AND FLORA

The renewable energy facilities listed in Table 16.1 are located in the area where the Succulent Karoo Biome and the Fynbos Biome are intermixed. Whilst the majority of the renewable energy sites are likely to be established on existing farms where some disturbance has already occurred, there may be numerous different plant communities present, each associated with different combinations of soil depth and texture, aspect and slope, creating a wide range of potential habitats for resident biota. The sensitivity and conservation worthiness of these areas may differ. At the landscape scale, the density of these developments is still relatively diffuse and each lies within different mountain ranges and vegetation types.

The total land take of each facility is likely to range between 2% to 3% of the total area allocated for the facility. The majority of these facilities are likely to be placed on existing farm lands where either crop farming or grazing takes place. A potential cumulative impact of wind farm developments identified by the specialists is the potential loss of connectivity of the landscape and the disruption of faunal movement pathways and a possible reduction in the ability of plants and animals to respond to climate variability and change. The nature and potential extent of this impact however, is very difficult to quantify. The current development is largely concentrated on the ridges of the site, which potentially impacts the functioning of the ridge as a corridor for faunal movement. It is feasible to mitigate potential site specific negative impacts on fauna and flora by avoiding sensitive patches of vegetation/habitat within specific site boundaries. While the cumulative impact is uncertain, and assuming site specific mitigation can avoid sensitive habitats, it is unlikely that the negative cumulative impact on fauna (excluding bats and birds) and flora resulting from the development of several renewable energy facilities in proximity to the proposed Roggeveld Wind Farm will be significant.

On the positive side, farmers may become less reliant on income from stock and/or crop farming as a result of increased incomes accruing to them from leasing their land to renewable energy developers. This may result in a decrease in numbers of animals per hectare which could ultimately result in an improvement in the flora and surrounding habitat. However, should farming intensity increase (additional stock or increase in crops lands/orchards) because of the increase income, some would argue that this could have a negative cumulative impact as additional land take may impact sensitive habitats. On the other hand the country is in need of increased

agricultural productivity and food security and it could thus be argued that positive impacts would result from increased agricultural activity as there will be more jobs created for the unemployed communities of the Laingsburg local municipality.

16.3 CUMULATIVE IMPACTS ON BIRDS

The cumulative impact on birds as a result of the development of several wind farm facilities in close proximity could be significant. International experience shows that there is a growing concern about the cumulative impacts that wind farms can have on birds. As with the site specific impacts, cumulative impacts on bird populations could include habitat destruction due to physical footprint of wind farms, disturbance and/or displacement by construction and maintenance activities and possibly by the operation of the facilities, and mortality caused by collision with the wind turbine blades, collision with the power line network associated with the Wind Farm, and electrocution on the required power line and substation infrastructure.

While site specific mitigation can be implemented, cumulative impacts are likely to become significant when a number of wind farm developments are located in key habitat types or affect specific bird species considered as of high conservation importance or species considered being vulnerable to wind farms by virtue of their behaviour or ecology[1]. Locally, only seven operational individual wind turbines exist in South Africa, too few to provide any meaningful data on the actual interactions of birds with wind farms[2]. This means that new proposed projects are assessed in the absence of any real local data or experience. There is a potential for cumulative impacts to be significant and more research is required to understand the uncertainties.

Discussions have been initiated between concerned NGO's (Endangered Wild Life Trust and Bird Life South Africa) and wind energy developers concerning cumulative impacts on birds. Numerous international research papers and discussion documents on the subject have been written and provide an essential platform on which to build a better understanding. As more data becomes available on the interaction with birds and wind farms in South Africa, methodologies for the assessment of cumulative impacts will need to be developed and adapted to take cognisance of local conditions. At this stage mitigation of cumulative impacts has been limited to recommending long term monitoring before construction and during the operational phase of the wind farms.

(1) Scottish Natural Heritage Guidance Cumulative Effects of Windfarms Version 2 revised 13.04.05

(2) https://www.ewt.org.za/WHATWEDO/OurProgrammes/WildlifeEnergyProgramme/OurProjects/WindEnergyandBirdsinSA.aspx

16.4 CUMULATIVE IMPACTS ON BATS

The many proposed wind farms are significant in terms of potential cumulative impacts on bats, increasing the risks for fatalities. It also increases the risks for clashes with bat migration routes.

Although there is not much known about the migration routes of bats in South Africa, we do know of two species that conduct seasonal migrations. In Gauteng, Limpopo and the Western Cape provinces, it has been reported that *Miniopterus natalensis* migrates up to 260 km (van der Merwe 1973a, 1975 cited in Monadjem *et al*, 2010) between warmer maternity caves where females give birth in summer (eg the De Hoop Guano Cave in the Western Cape, and several caves in the low veld of Limpopo), and colder caves in winter, where mating and hibernation occurs (eg several caves in the interior of the Western Cape, and on the highveld of Gauteng). *Myotis tricolor* undertakes similar seasonal migrations, although the details are not yet known.

The most well known large-scale bat roosts in the Northern and Western Cape are De Hoop Cave in the Western Cape and Koegelbeen Cave in the Northern Cape. There is evidence that some of these migrating bats may hibernate at Steenkampskraal, 560 km to the south-west of Koegelbeen Cave (Miller-Butterworth *et al*., 2003 cited in Monadjem *et al*, 2008). Natural Scientific Services visited Steenkampskraal at the beginning of September 2010 and there were high numbers *of M. natalensis* and *Rhinolophus sp.* present. It is Natural Scientific Service's opinion that there are many other caves and mine shafts where these bats roost or rest in during different seasons. *M. natalensis* is gregarious and can occur in the thousands, if movement between roosts does coincide with any of the proposed facilities, the impact would be much greater than individual fatalities.

16.5 CUMULATIVE VISUAL IMPACTS

Many of the sites and surrounds of the proposed Roggeveld Wind Farm have a wilderness or rural farmland character, typical of the Karoo landscapes. Most of the sites are remote and sparsely populated, which adds to their attraction as getaway destinations. The sheer scale of many of the projects ranging from 100 to few hundred turbines each (such as the case with this wind farm and the proposed Konstabel Wind Farm) associated infrastructure could result in a loss of scenic views and inspiring open space related to these landscapes. The alteration of the landscape from wilderness or rural farmland character to a more industrial type character will have an impact on the sense of place which in turn could have an impact on tourisms and associated activities. A single renewable energy facility located in an area of wilderness or rural farmland character is likely to attract interest, resulting in some positive benefits. However, it could be argued that it is unlikely that several such facilities in relatively close proximity are likely to have the same outcome.

The degree of cumulative impact is a product of the number of and distance between individual wind farms, the inter-relationship between their Zones of Visual Influence (ZVI), the overall character of the landscape and its sensitivity to wind farms, and the siting and design of the wind farms themselves[1]. Cumulative impacts need to be considered from both a visual amenity and landscape character perspective, while the impact on these may also have a bearing on the enjoyment of the natural heritage.

The cumulative impacts on visual amenity of all the renewable energy facilities, should many of them be constructed, will be largely influenced by three factors[2]:

Combined effects: these occur where a static observer is able to see two or more developments from one view point within the observer's arc of vision at the same time;

Successive effects: these occur where two or more wind farms may be seen from a static view point but the observer has to turn to see them;

Sequential effects: these occur when the observer has to move to another view point, for example when travelling along a road or footpath, to see the different developments. Sequential effects may range from *frequent* (the features appear regularly and with short time lapses between, depending on speed and distance) to *occasional* (long time lapses between appearance due to the lower speed of travel and/or the longer distances between the view points.

In the context of the recommendations of the Provincial Government of the Western Cape's guideline document for wind energy developments[3] it is encouraged that large concentrated wind farms should be developed rather than small dispersed locations where the distance between large wind farms is at least 30km, and ideally exceeding 50km. In this regard, the proposed Roggeveld Wind Farm is located north of the Konstabel Renewable Energy Facility, while Perdekraal Renewable Energy Facility is located approximately 30km away as shown in *Table 16.2*. The other known wind farms are in Sutherland and Suurplaat located north east of the Roggeveld Wind Farm.

The combined effect of the Roggeveld, Witberg, Konstabel, Perdekraal and Sutherland Wind Farms will have a cumulative visual impact and impact on the landscape character. The cumulative visual impact and impact on landscape character resulting from the other known wind farms in the surrounds of the Roggeveld Wind Farm is difficult to assess, but may be less significant due to the larger distances between the facilities.

[1] Scottish Natural Heritage Guidance Cumulative Effects of Windfarms Version 2 revised 13.04.05

[3] Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape Provincial Government of the Western Cape and CNdV Africa, 2006.

16.6 CUMULATIVE CULTURAL HERITAGE IMPACTS

From a cultural heritage perspective cumulative impacts are a reason for concern. The many proposals for wind farms or renewable energy facilities in the Karoo surrounds has been argued to amount to an industrialisation of the Karoo, with potential consequences for the aesthetic qualities of the region. The need to conserve the South African landscape cannot be under-estimated. The vast horizons of the country and the variety and qualities of the landscape contribute significantly to our communal identity, and make the country a primary tourism destination. However, it is also critical that renewable energy is encouraged. It is therefore necessary to identify and conserve iconic landscapes, but also allow some latitude so that more marginal areas can be utilised. In terms of its landscape qualities the study area is deemed to be significant and contributes aesthetically to the region. It is in terms of this factor that the greatest negative impacts are expected.

16.7 CUMULATIVE SOCIO-ECONOMIC IMPACTS

Benefits to the local, regional and national economy through employment and procurement of services could be substantial should many of the renewable energy facilities proceed. This benefit will increase significantly should critical mass be reached that allows local companies to develop the necessary skills to support construction and maintenance activities and that allows for components of the renewable energy facilities to be manufactured in South Africa. Furthermore at municipal level, the cumulative impact could be positive and could incentivise operation and maintenance companies to centralise and expand their activities towards education and training and more closely to the projects.

The cumulative impact in terms of loss of agricultural land is unlikely to be significant due to the limited land take and in most cases agricultural activities would be allowed to proceed. Property prices in these areas are likely to increase as a result of the added value that energy generation offers. However, once the renewable energy sector is saturated, property prices that are dependant on the sense of place value rather than on the agricultural potential may be compromised due to the changes in landscape and sense of place.

16.8 CONCLUSION

Cumulative impacts and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in South Africa. The degree of significance of these cumulative impacts is difficult to predict without detailed studies based on more comprehensive data/information on each of the receptors and the site specific developments. This however, is beyond the scope of this study.

The alignment of renewable energy developments with South Africa's National Energy Response Plan and the global drive to move away from the use of non-renewable energy resources and to reduce greenhouse gas emissions is undoubtedly positive. The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant. However, there is a lack of understanding of the cumulative impacts on other environmental and social receptors such as birds and bats, visual amenity and landscape character of the affected areas.

There is a need for strategic planning and cooperation to better understand the cumulative impacts that may result from promoting renewable energy. In this regard the Western Cape Department Environmental Affairs and Development Planning (DEA&DP) has recently initiated a Regional Strategic Environmental Assessment of Sites Suitable for Wind Farms. Furthermore, the Endangered Wildlife Trust and Bird Life South Africa have facilitated working groups to engage the wind energy sector on these issues. In order to better understand cumulative impacts, it is helpful to understand location of the various proposed and approved wind farm developments at any one time. In this regard the South African Wind Energy Association is collating spatial information on the approved and proposed wind farm developments of its members.

It is also important to reiterate that it is unlikely that all proposed wind farms located in the 25 to 75km radius will be built due to capacity constraints on the Eskom grid and the limits placed on renewable energy targets.