13 ARCHAEOLOGY, PALAEONTOLOGY AND CULTURAL HERITAGE IMPACTS

ERM appointed ACO Associates CC to conduct a heritage impact assessment for the proposed Richtersveld Wind Farm. The findings of this study are detailed in *Annex J* and summarized in this chapter.

This chapter discusses the potential impacts on archaeology, palaeontology and cultural heritage resources resulting from the establishment of the Wind Farm at the Richtersveld site including physical effects on sites and features of cultural heritage interest and broader landscape and visual effects on the site setting. The potential impacts are assessed and mitigation measures to reduce the impacts are outlined below.

No palaeontological material, apart from one small fragment of mineralised bone was observed during field investigations however it is possible that excavation may produce evidence of invertebrates (snails), old land surface and mineralised bones of Pleistocene animals. The pre-colonial archaeology of the Study Area is limited, and relatively sparsely distributed over the landscape. Key aspects of the Richtersveld site that are of archaeological interest include sites that are Late Stone Age in origin ranging between as old as 4000 years (Late Stone Age microlithic industry) as well as less than 2000 years in age (Late Stone Age ceramic period).

The cultural landscape of the area contains the living heritage of Nama herders who still use the area. The construction of wind turbines should not directly affect the herders who will continue to exercise a traditional way of life. However in an aesthetic sense, the turbines represent a very modern industrial and technological layer over a landscape characterised by an ancient lifestyle. The arid and relatively featureless landscape of the area is not an important tourism area. Although the large vertical intrusions of the wind turbines will be visible for many kilometres, the tourist on the R382 is likely to focus their attention on the coastal area and the views towards the *Boegoeberge* which are the most significant and scenic features on the landscape between Alexander Bay and Port Nolloth.

The proposed Wind Farm is likely to have a negative effect on archaeological, cultural and heritage resources during the construction and operational phases of the development as summarised in *Table 13.1*.

Table 13.1 Impact characteristics: Impacts on Archaeology, Palaeontology and Cultural Heritage

Summary	Construction	Operation
Project Aspect/ activity	(i) Disturbance of or damage to archaeological, cultural heritage sites or palaeontology resources associated with site preparation and construction activities.	(i) Visual or sense of place impact on cultural heritage features.
Impact Type	Direct	Indirect
Receptors Affected	(i) Archaeological and cultural heritage interests within site clearance areas. (ii) On-site fossils.	(i) Historic structures or features and the heritage value associated with the scenic value and farming history of the area. (ii) Directly affected landowners, neighbouring landowners, local communities, tourists, and drivers passing on the National Road (R382).

13.1 DISTURBANCE OR DAMAGE TO PALAEONTOLOGY, PRE-COLONIAL ARCHAEOLOGY AND CULTURAL HERITAGE RESOURCES

13.1.1 Impact Description and Assessment

Construction Phase Impact

The removal of top soil and excavation of the turbine and substation foundations and borrow pit, road construction and installation of cables each have the potential to interfere with archaeological and palaeontological resources present within the site boundary.

Palaeontology

The Richtersveld site is considered to be of low palaeontologist interest given that no fossiliferous deposits were observed during field investigations; however, evidence of invertebrates, old land surfaces and mineralised bones of Pleistocene animals may exist beneath the surface. Any deep intrusive works undertaken such as excavation for turbine foundations (up to 3.5 m in depth) and cable trenches (up to 1.5 m in depth) has the potential to impact such materials. It is expected, however, that the trenches and foundations

required will not be deep enough to intersect with any major fossil bearing sediments.

Box 13.1 Construction Impact: Destruction or Disturbance to the palaeontological heritage of the Study Area

Nature: Construction activities would result in a **negative direct** impact on palaeontological heritage of the Study Area.

Impact Magnitude – Minor

- **Extent**: The extent of the impact is **local**.
- **Duration**: The duration would be **permanent** as these resources are non-renewable and once destroyed, they can not be replaced.
- **Intensity**: Destruction or disturbance of palaeontological heritage will be of **low** intensity.

Likelihood – it is unlikely that localised palaeontological heritage would be lost.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **medium to high**.

Archaeology

The pre-colonial archaeology of the Study Area is limited, and relatively sparsely distributed over the landscape. All of the sites are Late Stone Age in origin ranging between as old as 4000 years (Late Stone Age microlithic industry) as well as less than 2000 years in age (Late Stone Age ceramic period).

In total 6 observations were made (see below). There are two archaeological sites of moderate significance and two archaeological sites of low significance within the Study Area which will require minor mitigation in terms of the proposed turbine positions and access roads. The two archaeological sites of moderate significance within the Study Area may require mitigation in terms of the proposed turbine positions (see *Figure 6.7*).

Site 3 (28°45'20.37"S 16°39'37.85"E) contains various limpets and a large amount of Cape Coastal Pottery, as well as informal looking quartz artefacts. The presence of pottery indicates that the site is likely to be less than 2000 years old. This site lies very close to locality WTG 5 which could mean that it may be impacted by construction activity (surface disturbance) relating to construction of turbine WTG 5 and the associated road.

Site 4 (28°45'16.69"S 16°39'26.84"E) lies close to a proposed access road and turbine WTG 4. If the construction area is not judiciously confined, disturbance of this archaeological site may result.

Site 6 (28°44'13.26"S 16°42'33.53"E), is the largest archaeological site, a Late Stone Age site predating the ceramic period which means that it is more than 2000 years old. It is associated with the only significant granite outcrop in the

Study Area. The site lies close to turbine WTG 26. Impacts (surface disturbance) from construction of the access road and the nearby turbine could affect this archaeological site

Sites 1 (28°45'38.68"S 16°39'57.47"E) and 5 (28°44'16.55"S 16°42'37.96"E) are highly ephemeral scatters and are therefore considered to be of very low significance, hence should they be impacted, the loss to the heritage record is of very low significance. Mitigation/conservation of sites 3, 4 and 6 will serve as an adequate record of the archaeological heritage of the Study Area.

Site 2 lies outside the Study Area.

Box 13.2 ***Construction Impact: Destruction or Disturbance to the pre-colonial archaeology and built environment of the Study Area***

Nature: Construction activities would result in a **negative direct** impact on pre-colonial archaeology and built environment of the study area

Impact Magnitude – Medium

- **Extent**: The extent of the impact is **local**.
- **Duration**: The duration would be **permanent** as these resources are non-renewable and once destroyed, they can not be replaced.
- **Intensity**: Destruction or disturbance of palaeontological heritage will be of **Medium** intensity.

Likelihood – There is a **definite** likelihood that the pre-colonial archaeology and built environment of the study area would be affected.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)

Degree of Confidence: The degree of confidence is **medium to high**.

Buried Graves

Namaqualand boasts possibly the longest unbroken record of human settlement in that Nama speaking herders who practise traditional lifestyles in the area are descendents of Khoekhoen populations who first came into southern Africa more than 2000 years ago. Thus the living heritage of the area suggests the possibility that human remains and lost graves may be encountered during construction.

Human remains may occur at any place on the landscape, but are particularly likely to be found on or close to archaeological sites. They are regularly exposed during construction activities. Such remains are protected by a plethora of legislation including the Human Tissues Act (Act No 65 of 1983), the Exhumation Ordinance of 1980 and the National Heritage Resources Act (Act No 25 of 1999).

Box 13.3 Construction Impact: Destruction or Disturbance of Buried Graves

Nature: Construction activities would result in a **negative direct** impact on cultural heritage of the Study Area.

Impact Magnitude – High

- **Extent**: The extent of the impact is **local**.
- **Duration**: The duration would be **permanent** as these resources are non-renewable and once destroyed, they can not be replaced.
- **Intensity**: Destruction or disturbance of burial graves will be of **high** intensity.

Likelihood – It is **unlikely** that buried graves will be damaged or disturbed.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MAJOR (-VE)

Degree of Confidence: The degree of confidence is **medium to high**.

13.1.2 Mitigating for impact of the construction of the turbines, substation, access roads and power line on palaeontological heritage, the pre-colonial archaeology and built environment of the Study Area

The objective of mitigation is to minimise impacts on archaeological and paleontological resources and ensure that opportunities to identify such resources, are maximised.

Design Phase

- It is recommended that Site 3, 4 and 6 are cordoned off or tagged as no –go areas so that they are excluded from construction activities. If this is not feasible the entire site will have to be systematically archaeologically sampled prior to commencement of construction.

- Mitigation of sites 1 and 5 is not critical, however in the interest of conservation, site 5 should be flagged and the access road deviated by about 20 m to the north to avoid it.

Construction Phase

- Should any human burials, archaeological or palaeontological materials (fossils; bones; artefacts; cultural Material such as historic glass, ceramics, etc; sub-surface structures, graves etc) be uncovered or exposed during earthworks or excavations, they must immediately be reported to the South African Heritage Resources Agency (SAHRA). After assessment and if appropriate a permit must be obtained from the SAHRA or HNC to remove such remains.

- Mitigation of palaeontological heritage can be achieved by ensuring that trenches and excavations are checked by a palaeontologist. The collection of new scientific information is a positive impact.

13.1.3 *Residual Impact*

Should the mitigation measures listed above be undertaken upon finds of palaeontological interest (fossils, bones, artefacts etc.), impacts will be considered positive as the finds will be documented and data can be added to existing scientific data of the region. In addition, Site Layout Alternative 2 avoids sites 3, 4 and 6 thus palaeontological heritage and the pre-colonial archaeology of the study area will be largely safeguarded.

Should the design phase mitigation measures be implemented into the Final Layout (Alternative 2), including the deviating of the access road by about 20 m to the north to avoid Site 5, the palaeontological and pre-colonial archaeology value of the study area will not be jeopardised. In summary, should the design, operational and construction phase mitigation be implemented, the significance of the residual impacts associated with damage or destruction to archaeology, buried graves and cultural heritage resources will be reduced to minor (see *Table 13.2*).

Table 13.2 Pre- and Post-Mitigation Significance: Damage or destruction to Archaeological and Paleontological Resources

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Impact on the palaeontological heritage	**MINOR (-VE)**	**MINOR - MODERATE (-VE)**
Impact on pre-colonial archaeology and built environment Construction	**MODERATE (-VE)**	**MINOR (+VE)**
Impact on Graves Construction	**MAJOR (-VE)**	**MINOR (+VE)**
Operation	**N/A**	**N/A**

13.2 *VISUAL OR SENSE OF PLACE HERITAGE IMPACT*

13.2.1 *Impact Description and Assessment*

Operational Phase Impacts

Wind farms and their associated infrastructure can change the visual and acoustic character of an area by introducing large-scale structures and machinery into previously undeveloped areas, particularly in rural areas. This includes the wind turbines themselves, as well as electrical transmission lines, substation complex, maintenance staff, vehicles and maintenance equipment.

The cultural landscape of the area contains the living heritage of Nama herders who still use the area. Within the Study Area today, is evidence of some 10 active or recently active stock-posts. Although the '*matjiehuisies*' are no longer built of traditional materials, they are rendered in modern materials and the style and size of the encampments follow traditional form. The stock-

posts are actively used indicating the people are practising traditional herding activities in the area today.

The construction of wind turbines should not affect the herders who will continue to exercise a traditional way of life. Aesthetically however the turbines represent a very modern industrial and technological layer over a landscape characterised by an ancient lifestyle, however the area is remote, arid and does not form part of any area with special landscape qualities (*Figure 13.1*). While the Richterveld is held in high esteem as a wilderness destination, the Study Area holds little interest to tourists and is seldom visited (if ever) by tourists.

Figure 13.1 View from within the Study Area looking south east towards the escarpment.

The proposed wind farm complex may have a visual impact on the cultural landscape with respect to motorists travelling along the R382. The arid and relatively featureless landscape of the area is not an important tourism area. Although the large vertical intrusions of the of the wind turbines will be visible for many kilometres, the tourist on the R382 is likely to focus their attention on the coastal area and the views towards the *Boegoeberge* which are the most significant and scenic features on the landscape between Alexander Bay and Port Nolloth. Alternatively, people passing through the area are most

likely going to value the experience of viewing the wind farm en route to other destinations.

Box 13.4 Operational Impact: Visual or Sense of Place Heritage Impact

Nature: The impact on sense of place heritage is most likely going to be experienced as a **direct, negative** impact by the affected stakeholders.

Impact Magnitude – Medium

- **Extent**: The extent of the impact is **local**, since the visual influence would extend beyond the site.
- **Duration**: The duration would be **long-term** as the visual character of the site would be altered at least until the project stopped operating.
- **Intensity**: The intensity will be **medium** for local people who do not support the proposed development and will be impacted by noise and visual disturbance and who may not adapt easily to the change.

Likelihood – There is a **definite** likelihood that the sense of place will be impacted by the presence of the turbines in the Richtersveld area.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)

Degree of Confidence: The degree of confidence is **medium**.

13.2.2 Mitigation of Visual or Sense of Place Heritage Impact

There is no mitigation possible for this potential impact. Even a reduction in the number of turbines would not significantly reduce the significance rating of this impact. Effective down lighters on the turbines could possibly reduce the night time impacts somewhat.

13.2.3 Residual Impact

As there is no mitigation possible for this potential impact, there would be no difference in the residual impact, and the potential impact would remain of major-moderate significance (see *Table 13.3*).

Table 13.3 Pre- and Post- Mitigation Significance: Cultural Heritage Visual or Sense of Place

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Impact on Cultural Heritage/ Visual Sense of Place Operation	**MODERATE (-VE)**	**MODERATE (-VE)**

14 SOCIO-ECONOMIC IMPACTS

14.1 BENEFITS FOR THE LOCAL ECONOMY

14.1.1 Impact Description and Assessment

The development of the wind farm will result in significant spending in South Africa having a positive impact on the national, regional and local economy to varying degrees. Direct benefits such as employment and procurement associated with the project will have the most significant impact when compared to indirect and induced impacts. However, over time as the renewable sector develops additional benefits to the national economy may accrue as the supply chain to the renewable energy sector develops. The direct benefits will be most significant during the construction phase of the project, and are likely to have the largest influence on the local economy. *Table 14.1* below provides a summary of the description of this impact.

Table 14.1 Impact Characteristics: Benefits for the Local Economy

Summary	Construction	Operation
Project Aspect/ activity	Employment and procurement of local contractors. Lease agreements with directly affected farmers.	Employment and procurement of local contractors. Lease agreements with directly affected farmers. Development of the supply chain for the wind energy sector.
Impact Type	Direct, positive impact.	Direct, indirect and induced positive impact.
Stakeholders/ Receptors Affected	Local community, Local Municipality, and directly affected landowners.	Local community, Local Municipality, suppliers throughout South Africa and Directly Affected Landowners.

Construction Phase Impacts

The capital investment required for the renewable energy facilities is high an estimated at approximately R2.25 billion which will be spent over a 24 month period. During the construction phase the civil and other construction, specialised industrial machinery and building construction sectors would benefit the most. Local procurement will primarily benefit the civil and construction industry, hospitality and service industries, such as accommodation, cleaning, transport, vehicle servicing and security services.

The highly specialised nature of the machinery required for the proposed project will, however, require that the majority of the technical components associated with the wind turbines be imported from specialist suppliers. The renewable energy sector is still relatively small in South Africa and as such it is unlikely that appropriate supplies and service providers are currently available in the country; this may, however, change over time. It is currently

estimated that 70 percent of the project spend will be on turbines which will be imported, 20 percent will be on the balance of plant (buildings, substations etc) and ten percent on development. While the value of imports is high, it is likely that the majority of the balance of plant will be sourced from South Africa, resulting in a significant spend in the economy.

It is estimated that approximately 111 local construction jobs will be created for the duration of the construction and commissioning phases which is estimated to be 24 months. A further five to seven jobs will be filled by highly specialised foreign staff.

There are high levels of unemployment in the project area; the most common skills are in the mining, fishing and farming sectors. It is anticipated that there will be further retrenchments from the mines, as such exacerbating the levels of unemployment. It is intended that G7 and its contractors will source the majority of the unskilled workers from the surrounding municipal area with the remainder being sourced regionally, where they are not available locally. In the local municipal context, this translates into a significant benefit to the local unemployed population, even though these opportunities will be for the short term i.e. for the duration of the construction phase.

It is unlikely that there are many people with the required skills available to fill highly-skilled and semi-skilled opportunities at the local municipal level. There may be more suitably highly and semi-skilled people available at the provincial and national levels.

Initial recruitment and training for local personnel will take place prior to and during the construction phase, in conjunction with G7's contractors. Tasks on site will require skills in a number of areas, including working at height, electrical safety, specific maintenance and troubleshooting, isolation for maintenance, etc. The construction work will create an opportunity for 'on-the-job' training thus increasing general skills levels. The opportunities for skills development and training would extend through from skilled to unskilled personnel. G7 will notify identified representatives of the local municipality of the specific jobs and the skills required for the project. This will give the local population time prior to the beginning of construction and operation to enable them to attain the relevant skills/qualifications. *Box 14.1* describes the construction phase related impact of benefits for the local economy.

Box 14.1 Construction Impact: Benefits for the Local Economy

Nature: The benefit to the local economy will be **direct** via employment and procurement of services and **indirect** via spending in the local economy due to increase in wages etc.

Impact Magnitude – Medium

- **Extent:** Employment and procurement of service will be created for South African's at a **local, provincial and national** level depending on skills and capacity availability.
- **Duration:** Employment generated during the construction phase will take place over a 12 to 21 month period and will therefore be **short-term**.
- **Intensity:** The intensity will be **medium** as there will be approximately 131 jobs created with approximately 30 percent of the total investment being spent on goods and services in South Africa during the construction phase.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MODERATE POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

Operational Phase Impacts

Direct benefits

Similar to the construction phase, the majority of goods and services will be highly specialised and technical in nature with up to 70 percent of the operational expenditure being initially imported in the form of expatriate engineers. Locally procured services will include maintenance work for balance of plant facilities, 24 hour security and cleaning contracts resulting in an ongoing investment injection. Over time, as businesses develop locally to meet the needs of the renewable energy sector, levels of procurement may increase.

Turbine operation is largely automated with routine scheduled services taking place on average twice per annum. There will be a dedicated operations team comprising of approximately 39 full time personnel operating the facility in daytime hours. The types of jobs that will be generated during the operations phase are likely to include:

- 14 technicians (including Site Manager and Supervisor);
- 14 apprentices;
- four high voltage engineers (1);and
- seven administrative staff.

In addition, there will be a number of contract jobs including skilled balance of plant (transformers, substation, electrical connections etc) maintenance personnel for electrical balance of plant works and crane operators/crew. There are likely to be additional jobs including a number of personnel to cover 24 hour site security, as well as some cleaning contracts. These personnel will

(1) High Voltage Engineers are persons trained to handle and manage high voltage power lines

be sourced locally at the municipal level where possible. If the appropriate skills are not available at the municipal level these services will be sourced regionally.

General training will be provided in management systems and wind turbine performance review. Much of the knowledge regarding wind turbine operations and maintenance will be acquired 'on-the-job'. It is envisaged that G7 operations personnel will be increasingly trained up and qualified to high levels over a 5-6 year timeframe, consistent with demonstrated capability and ambition.

The landowners (CPA) will receive payments from G7 for the use of the land for the life of the proposed project and the value of the directly affected farms are likely to increase as a result of the added income stream. The wind farm will occupy approximately one percent of the farm area, allowing the existing agricultural activities to continue. This will enable the CPA to supplement their existing income which should be to the direct benefit of the affected Richtersveld Community.

Indirect and induced benefits

Apart from the direct benefits resulting from the operational spend and direct jobs created, the spending of those employed directly would result in a positive indirect impact on the local and regional economy. Furthermore, additional indirect jobs will be created by the presence of the construction and operations teams' need for accommodation, food and other essentials.

The CPA has no definite plans for the income they will be receiving from the development, the community will jointly make the decision. The CPA noted that they will undertake a needs assessment of the broader area and consult with the four communities to determine specific needs and requirements. It is highly likely that the income will be invested in infrastructural development and job creation.

The potential for the proposed project and other future projects to result in greater impacts on local economies and the South African economy as a whole is primarily dependent on economies of scale. Initially import content will be high. However, if the sector grows in size it should provide opportunities for growth of the local supply chain and the additional benefit that would flow from this. The introduction of a large-scale renewable energy programme could provide local economic opportunities for component manufacture, and with an appropriate industrial policy it would be possible to leverage South Africa's relatively cheap steel resources. The distance from other international manufacturers will also confer a competitive advantage, especially for less-specialised large-scale components such as steel towers. *Box 14.2* describes the operation phase related impact of benefits for the local economy.

Box 14.2 Operational Impact: Benefits for the Local Economy

Nature: The benefit to the local economy will be **direct** via employment and procurement of services and **indirect** and induced benefits via the spend in the local economy due to increase in wages; local supply chain etc.

Impact Magnitude – Medium

- **Extent:** Employment and procurement of service will be created for South African's at a **local, provincial and national** level depending on skills and capacity availability.
- **Duration:** Employment and procurement of services will be generated during the operational phase over a period of 25 years and will therefore be **long-term**.
- **Intensity:** The intensity will be **low-medium** in the short term as the majority of services will be imported. As the sector matures, the intensity is likely to increase with additional benefits to the economy through the increased employment of local suppliers, increase job opportunities on the farms and increase in the local turbine manufacturing sector.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – MODERATE POSITIVE

Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

14.1.2 Mitigation and Enhancement

The objective of enhancement is to optimise opportunities for employment and procurement of local labour and services, wherever possible, or alternatively procurement at a regional or national level.

Community Development:

G7 should continue, as is their stated intention, to explore ways to enhance local community benefits with a focus on broad-based BEE through mechanisms such as community shareholding schemes and trusts. At this preliminary stage, and in accordance with the relevant BEE legislation and guidelines, up to four percent of after tax profit could be used for community development over and above that associated with expenditure injections into the area. As such;

- G7 to establish a Community Development Trust for the advancement of local development needs; specifically at the farm level.
- G7 to establish a Community Development Trust for the advancement of local development needs; specifically at the local municipality level.
- Depending on the electricity tariff the project will be elected with, the project will contribute towards the local community within or above the required criteria set by the DoE (Department of Energy).
- Projects would be identified in collaboration with the land owners (CPA) as well as other local stakeholders to improve general living conditions and access to better living standards in the broader area.

- Projects would 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.

- All projects would be aligned with G7's policies.

Employment and Procurement:

It is important to recognise that the nature of the project dictates that large proportions of specialist skills and materials will have to come from outside of South Africa as well as the local municipal area with a high portion of international imports. However, the objective of enhancement is to optimise opportunities for employment/procurement of local people/suppliers or alternatively that employment and procurement opportunities are enhanced on a regional or national basis, where possible.

The following measures will be implemented to ensure that employment of local people is maximised and procurement of local, regional and national services is maximised:

- G7 will establish a recruitment and procurement policy which sets reasonable targets for the employment of South African and local residents /suppliers (originating from the local municipality) and promote the employment of women as a means of ensuring that gender equality is attained. Criteria will be set for prioritising, where possible, local (local municipal) residents/suppliers over regional or national people/suppliers. All contractors will be required to recruit and procure in terms of G7's recruitment and procurement policy.

- G7 will work closely with relevant local authorities, community representatives and organisations to ensure that the use of local labour and procurement is maximised. This may include:
  - sourcing and using available databases on skills/employment-seekers that local authorities may have;
  - advertising job opportunities and criteria for skills and experience needed through local and national media; and
  - conducting an assessment of capacity within the Local Municipality and South Africa to supply goods and services over the operational lifetime of the project.

- G7 to work closely with the wind turbine suppliers to provide the requisite training to the workers. The training provided will focus on development of local skills.

- No employment would take place at the entrance to the site. Only formal channels for employment would be used.

- All skill requirements to be communicated to the local communities via appointed people prior to the commencement of the construction phase.

- G7 to work closely with the wind turbine suppliers to provide the requisite training to the workers. The training provided would focus of development of local skills.

- Ensure that the appointed project contractors and suppliers have access to Health, Safety, Environmental and Quality training as required by the Project. This will help to ensure that they have future opportunities to provide goods and services to the sector.

14.1.3 Residual Impact

The implementation of the above measures would ensure that the construction impacts remain of medium significance and ensure that the significance of the operation impact remains moderate and positive. The pre- and post- enhancement impacts are compared in *Table 14.2*.

Table 14.2 Pre- and Post- Enhancement Significance: Benefits for the Local Economy

Phase	Significance (Pre-enhancement)	Residual Impact Significance
Construction	**MODERATE (+ve)**	**MODERATE (+ve)**
Operation	**MODERATE (+ve)**	**MODERATE (+ve)**

14.2 INCREASED SOCIAL ILLS LINKED TO INFLUX OF WORKERS AND JOB-SEEKERS

14.2.1 Impact Description and Assessment

The introduction of construction activity in remote, rural environments can sometimes bring about social change. This change is typically due to an influx of workers and job-seekers into the area. As a worst-case scenario, these changes have been known to increase levels of crime, drug and alcohol abuse, increased incidence of sex workers, and domestic violence.

The Project area is located outside town in a predominantly rural setting. The population density of the immediate area is low and the majority of land is farmland. The only people living on the proposed project site and on the neighbouring farms are the landowners and their farm workers. An influx of 'outsiders' could pose a risk to existing family structures and social networks. *Table 14.3* below provides a summary of the description of impact.

Table 14.3 Impact Characteristics: Increased Social Ills

Summary	Construction	Operation
Project Aspect/ activity	Construction staff on site and potential influx of job-seekers.	Operation staff on site.
Impact Type	Direct and indirect, negative impact	Direct, negative impact

Summary	Construction	Operation
Stakeholders/ Receptors Affected	Local residents of the area, most specifically landowners of directly affected farms and neighbouring farms.	Local residents of the area, most specifically landowners of directly affected farms and neighbouring farms.

Construction Phase Impacts

G7 has estimated that there will be approximately 111 people employed during the construction phase, which they have estimated will take approximately 24 months. Due to the early phase of this project, specific arrangements have not yet been made regarding worker accommodation and terms of employment. Given that the proposed project is located along the R386, it is likely that the workers (from outside the area) will be accommodated in/close to the town of Alexander Bay. This will increase the levels of interaction with the local communities. The majority of workers are likely to be male and living away from their families.

The most likely social ills that may occur as a result of the increased number of workers and job-seekers are described below.

- **Theft of livestock** is already problematic on farms located close to towns, roads and in areas where construction work is taking place. It is likely that stock theft will continue and possibly increase during the construction phase.

- **Petty crimes** (e.g. theft of tools, household items and farm materials) on the project affected farm and neighbouring farms could occur.

- An increase in disposable income within the project area (among workers) could result in an **increase in alcohol and drug abuse**, **increased incidences of prostitution and casual sexual relations.** These sexual relations could result in increased incidents of HIV/AIDS and increased numbers of unwanted pregnancies.

Given the relatively small numbers of workers and job-seekers, it is likely that this impact will be relatively limited. In addition, the skilled workers are more likely to be housed in formal accommodation facilities and are unlikely to exacerbate this impact and the low skilled workers are likely to be local residents and as such already part of the community social structures and family networks. *Box 14.3* describes the construction phase impact of increased social ills.

Box 14.3 Construction Impact: Increased Social Ills

Nature: The social ills likely to accompany the Project would be regarded as an **indirect, negative** impact.

Impact Magnitude – Low

- **Extent:** It is anticipated that the potential social ills will have impacts at the **local** scale.
- **Duration:** The social ills likely to accompany the Project are expected to be **short-term**.
- **Intensity:** The intensity will be **low** as people should be able to adapt with relative ease.

Likelihood – It is **likely** that this impact will occur during the construction phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **medium** given that the extent of the influx of job-seekers is unknown.

Operation Phase Impacts

During the operational phase, there are going to be a limited number of workers (30 to 39) and/or contractors' onsite. As such, it is unlikely that there will be any social ills linked to the project activities. *Box 14.4* describes the operation phase impact of increase social ills.

Box 14.4 Operational Impact: Increased Social Ills

Nature: The social ills likely to accompany the proposed project would be regarded as an **indirect, negative** impact.

Impact Magnitude – Negligible

- **Extent:** It is anticipated that the potential social ills will have impacts at the **local** scale.
- **Duration:** The social ills likely to accompany the proposed project are expected to be **long-term** for the duration of the project.
- **Intensity:** The intensity will be **negligible** as people should be able to adapt with relative ease.

Likelihood – It is **likely** that this impact will occur during the operation phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE

Degree of Confidence: The degree of confidence is **medium** given that the extent of the influx of job-seekers is unknown.

14.2.2 Mitigation

The objectives of mitigation are:

- to limit, where possible, social ills brought about by the construction and operation of the wind farm; and

- to ensure that contractors manage their workers in such a way that the impacts on local communities are limited.

Specific measures include:

- G7 and its appointed contractors to develop an induction programme, including a Code of Conduct, for all workers (G7 and contractors including their workers) directly related to the project. A copy of the Code of Conduct to be presented to all workers and signed by each person.

- The Code of Conduct must address the following aspects:
  - respect for local residents;
  - respect for farm infrastructure and agricultural activities;
  - no hunting or unauthorised taking of products or livestock;
  - zero tolerance of illegal activities by construction personnel including: unlicensed prostitution; illegal sale or purchase of alcohol; sale, purchase or consumption of drugs; illegal gambling or fighting;
  - compliance with the Traffic Management Plan and all road regulations; and
  - description of disciplinary measures for infringement of the Code of Conduct and company rules.

- If workers are found to be in contravention of the Code of Conduct, which they signed at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. Stock theft should be noted as a dismissible offence.

- G7 will implement a grievance procedure that is easily accessible to local communities, through which complaints related to contractor or employee behaviour can be lodged and responded to. G7 will respond to all such complaints. Key steps of the grievance mechanism include:
  - Circulation of contact details of 'grievance officer' or other key G7 contacts.

  - Awareness raising among local communities (including all directly affected and neighbouring farmers) regarding the grievance procedure and how it works.

  - Establishment of a grievance register to be updated by G7, including all responses and response times.

- G7 and its contractors will develop and implement an HIV/AIDS policy and information document for all workers directly related to the project. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS. G7 will make condoms available to employees and all contractor workers.

- 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.

14.2.3 Residual Impact

The implementation of the above mitigation measures should ensure that the construction impacts remain of minor significance, and the operation impact of negligible significance. The pre- and post-mitigation impacts are compared in *Table 14.4*.

Table 14.4 Pre- and Post- Mitigation Significance: Increased Social Ills

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (-ve)**	**MINOR (-ve)**
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

14.3 DISRUPTION TO AGRICULTURAL ACTIVITIES

14.3.1 Impact Description and Assessment

The Nama people (the landowners) practice seasonal transhumant cycle [(1)]. This means that they are not nomadic but tend to use a specific area on a seasonal basis. They often do not divide the land into camps but enact cattle posts and huts which are used by herd boys each season they are herding the livestock in the area. *Table 14.5* below provides a summary of the impact.

Table 14.5 Impact Characteristics: Disruption to Agricultural Activities

Summary	Construction	Operation
Project Aspect/ activity	Construction activities. Access through farm gates. Employment of local workers.	Operation activities. Access through farm gates.
Impact Type	Direct, negative impact.	Direct, negative impact.
Stakeholders/ Receptors Affected	Directly affected farmers, and neighbouring farmers.	Directly affected farmers, and neighbouring farmers.

Construction Phase Impacts

The grazing area is large and unfenced. Their use of the grazing land is occasional in nature given that the herders are nomadic. During the construction phase, there is unlikely to be much disruption to agricultural activities. There will be site clearance, road construction, assembly and installation of wind turbines, as well as the construction of associated infrastructure. The landowners will need to keep their livestock in alternative

[(1)] Transhumance is defined as 'seasonal moving of livestock to regions of different climate'. It is an integral part of livestock production in many parts of the world and takes several forms including moving of livestock from lowland to mountainous pastures or from dry to humid areas.

grazing land in order to ensure that the stock are not harmed or lost as a result of the intensive construction methods.

Box 14.5 describes the construction phase impact of disruption to agricultural activities.

Box 14.5 Construction Impact: Disruption to Agricultural Activities

Nature: The disruption to agricultural activities would be regarded as a **direct, negative** impact.

Impact Magnitude – Low

- **Extent:** It is anticipated that the disruption to agricultural activities will be experienced at the **local** level.
- **Duration:** The disruptions will be experienced during the construction phase and as such will be **short-term**.
- **Intensity:** The intensity will be **low** as the herders use the land very occasionally.

Likelihood – It is **likely** that this impact will occur during the construction phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **high.**

Operation Phase Impacts

The disruption of farm activities during the operational phase is going to be significantly less. There will be substantially fewer vehicles on site and the stock will not be limited to the camps that are unaffected by the proposed project. During operation, the stock will be able to graze freely as the project activities will not affect the grazing land. *Box 14.6* describes the operation impact of disruption to agricultural activities.

Box 14.6 Operational Impact: Disruption to Agricultural Activities

Nature: The disruption to agricultural activities would be regarded as a **direct, negative** impact.

Impact Magnitude – Low

- **Extent:** It is anticipated that the disruption to agricultural activities will be experienced at the **local** level.
- **Duration:** The disruptions will be experienced throughout the operation phase and as such will be **long-term**.
- **Intensity:** The intensity will be **low** as the farmers will be able to adapt with relative ease during the operational phase.

Likelihood – It is **unlikely** that this impact will occur during the operational phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – NEGLIGIBLE

Degree of Confidence: The degree of confidence is **high.**

14.3.2 Mitigation

The objective of mitigation is to minimise the disruption to agricultural activities as related to the construction and operational phase activities.

Specific measures include:

- The construction schedule to be agreed with the CPA and the herders who use the land on a seasonal basis.
- All workers will agree to the Code of Conduct and be aware that contravention of the Code could lead to dismissal (as outlined in *Section 14.2*).
- All directly affected and neighbouring farmers will be able to lodge grievances with G7 using the Grievance Procedure as outlined in *Section 14.2*.

14.3.3 Residual Impact

The implementation of the above mitigation measures would reduce the construction impacts from medium to low significance and the operation impacts from low to negligible. The pre- and post-mitigation impacts are compared in *Table 14.6*.

Table 14.6 Pre- and Post- Mitigation Significance: Disruption to Agricultural Activities

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (-ve)**	**NEGLIGIBLE**
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

14.4 LOSS OF AGRICULTURAL LAND

14.4.1 Impact Description and Assessment

Currently, there are several relevant pieces of legislation that apply to the change of land use; they are the Northern Cape Planning and Development Act (No. 7 of 1998), Municipal Systems Act (No 32 of 200), Land Use Planning Ordinance of 15 of 1985, Land Use Management Bill (No. 280 of 2011) and the Subdivision of Agricultural Land Act No 70 of 1970.

In addition, an intergovernmental meeting was held in October 2010 by the *Department of Energy, National Department of Agriculture and the South African Wind Energy Association* to discuss guidelines for the regulation of wind farm uptake of agricultural land. The new draft guidelines state the following regarding the establishment of renewable energy facilities on land currently used for agricultural purposes:

- No wind farming structures, its foot print, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed on high potential or unique agricultural land as has been determined or identified by (Department of Agriculture, Forestry and Fisheries) DAFF or the relevant provincial Department of Agriculture through its existing or future developed spatial information data sets and /or through a detail agricultural potential survey.

- No wind farming structures, its foot print, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed on areas currently being cultivated (cultivated fields/ production areas) or on fields that have been cultivated in the last ten years. This is relevant to cultivated land utilised for dry land production as well as land under any form of irrigation.

- No wind farming structures, its foot print, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed to intervene with or impact negatively on existing or planned production areas (including grazing land) as well as agricultural infrastructure (silos, irrigation lines, pivot points, channels, feeding structures, dip tanks, grazing camps, animal housing, farm roads etc).

- No wind farming structures, its foot print, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed to result in a degradation of the natural resource base of the farm or surrounding areas. This include, but are not limited to, the limit of soil degradation or soil loss through erosion or any manner of soil degradation, the degradation of water resources (both quality and quantity) and the degradation of vegetation (composition and condition of both natural or established vegetation.

Table 14.7 provides a description of the impact.

Table 14.7 Impact Characteristics: Loss of Agricultural Land

Summary	**Construction and Operation**
Project Aspect/ activity	Land take for the construction and operation of the facility.
Impact Type	Direct, negative impact.
Stakeholders/ Receptors Affected	Directly affected landowners, Local, Provincial and National Government.

Construction and Operation Phase Impacts

The construction and operation of the proposed wind farm will require that approximately one percent of the identified land parcel/s will be taken for the construction and operation of the wind farm. The landowners have considered this land loss and believe that this will not require a down-scaling of agricultural activities. On the contrary, the landowners plan to expand agricultural activities and create jobs using the income generated from G7.

Box 14.7 below describes the impact of the loss of agricultural land for both the construction and operational phases of the proposed project.

Box 14.7 Construction and Operation Impact: Loss of Agricultural Land

Nature: The impact on agricultural land is going to be experienced as a **direct, negative** impact.

Impact Magnitude – Low

- **Extent:** The impact on agricultural land resulting from the construction and operation activities will occur at the **local/regional** level.
- **Duration:** This impact will occur for the duration of the construction and operation phases and will therefore be **long-term**.
- **Intensity:** The intensity will be **low** as limited agricultural land will be lost.

Likelihood – It is **likely** that this impact will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **high**.

14.4.2 Mitigation

The objective of mitigation is to minimise the loss of agricultural land resulting from project related activities during construction and operational phases.

Specific measures include:

- G7 to minimise the damage to farmland caused by construction activities by ensuring strict compliance with construction plans to minimise the development footprint and to implement a 'Code of Conduct' governing workers.
- G7 to design the infrastructure layout in a manner that limits the footprint of the facility and all associated infrastructure.
- Any damage to vegetation would be rehabilitated in accordance with mitigation proposed for the rehabilitation of natural vegetation in *Chapter 7*.

14.4.3 Residual Impact

The implementation of the above mitigation measures would ensure that the construction and operation impacts are reduced from minor to negligible significance. The pre- and post-mitigation impacts are compared in *Table 14.8*.

Table 14.8 Pre- and Post- Mitigation Significance: Loss of Agricultural Land

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction and Operation	**MINOR (-ve)**	**NEGLIGIBLE**

14.5 TOURISM ACTIVITIES

14.5.1 Impact Description and Assessment

Tourism in the area is currently underdeveloped due to the remoteness of the area and most of the land in the area has restricted access because of diamond mining activities. One of the strategic objectives of the local municipality is to support tourism development within the municipal area as part of local economic development. Tourism is seen as a means to diversify the economic potential of the LM (1). Most of the tourism market is dominated by 4x4 visitors to the RNP. Although large numbers of cars pass through the area very few benefits directly reach the people living in the area.

The landowners have plans to promote and increase tourism activities in the area. The presence of a wind farm may have positive impacts on tourism. *Table 14.9* describes the impact of tourism activities.

Table 14.9 Impact Characteristics: Tourism Activities

Summary	**Construction and Operation**
Project Aspect/ activity	Construction of the wind farm.
Impact Type	Direct, negative impact
Stakeholders/ Receptors Affected	Tourism operators in the area, directly affected landowners, neighbouring landowners, road users, and interested people.

General Discussion

There have been relatively few wind energy facilities in developing countries and certainly no studies reviewing the impacts of wind energy facilities on the local communities, economy or tourism in developing countries. As such, we rely heavily on learning's from research that has been undertaken in developed countries. There are numerous wind energy facilities in developed countries that have used the technology for a relatively long period of time and have been able to reflect upon some of the impacts caused by these facilities. In South Africa, there are currently two wind farms, one is located in Darling, which was commissioned by the government in 2002 and the other is a demonstration facility in Klipheuwel near Durbanville in the Western Cape Province. The Darling Wind Farm is a small facility consisting of only four turbines. There has not been much information shared with the public in terms of the wind farm's impacts on the surrounding communities, economy or tourism. This assessment is, therefore, based primarily on studies undertaken in developed countries as well as input from interviewees.

The indirect effects of wind farms on tourism have been the subject of substantial debate, but no evidence has been presented to support the view that wind farms have a negative effect on tourism. Results from numerous

(1) Richtersveld Local Municipality: Integrated Development Plan Review, 2009

surveys demonstrate that the effect of wind farms on tourism is negligible at worst, with many respondents taking a positive view to wind farms, and saying it would not affect their likelihood of returning to an area [1] . A study by Glasgow Caledonian University, looking into the impacts of wind farms on Scottish tourism, found that 75 percent of tourists surveyed felt that wind farms had a positive or neutral impact on the landscape [2].

The evidence supporting the impacts of wind farms on tourism is, however, contradictory. There are studies (based in Scotland) that provide conflicting findings about actual and perceived impacts. *Box 14.8* presents some contradictory findings related to the Scottish experience.

Box 14.8 Scottish Findings Regarding the Impacts of Wind Facilities

- VisitScotland commissioned independent research on the potential impacts of the development of wind farms on tourism in Scotland. This study concluded that 29 percent of respondents felt that wind farms and turbines had detracted from their experience [3] and 31 percent of respondents considered that the scenery and landscape would be spoiled by wind farm developments.

- In contrast a poll carried out by MORI Scotland found that 91 percent of respondents said that the presence of wind farms in the area made no difference to whether they would return (4). In a similar survey carried out for the Scottish Executive of people living close to wind farms, MORI Scotland found that most people felt that wind farms had had neither a positive or negative impact on their area. Of the remainder, 20 percent said it had had a broadly positive impact and 7 percent thought that there was a negative impact [5]. In Cornwall, wind farms have provided a unique visitor attraction and in addition they act as an invaluable educational facility for renewable energy.

According to other studies undertaken in the United Kingdom, Scotland and Australia by the respective Wind Energy Agencies [6], tourism has not been negatively affected by the establishment of wind energy facilities. Surprisingly, in contrast, wind energy facilities have been credited with increasing tourism activities and in turn also positively impacting on the local economy [7].

Experience in Scotland has shown that people are fascinated by wind turbines and often travel via the wind energy facilities *en route* to their final destinations. As a result, the construction of new wind energy facilities often includes the construction of a lay-by area so that passing traffic can park safely in order to view the turbines. Many recent planning applications have been modified by the developers to incorporate a viewing platform and visitor

(1) BWEA (2006) The Impact of Wind Farms on the Tourist Industry in the UK.
(2) Glasgow Caledonian University (2007). The Economic Impacts of Wind Farms on Scottish Tourism. Report commissioned by the Scottish Government.
(3) NFO System Three, Investigation into the Potential Impact of Wind Farms on Tourism in Scotland - Final Report.
(4) MORI (2002) Tourist Attitudes towards Wind Farms. Research Study Conducted for Scottish Renewables Forum & the British Wind Energy Association.
(5) MORI (2003) Public Attitudes to Wind Farms, Scottish Executive Energy Policy Unit.
(6) BWEA (2006) Impact of Wind Farms on Tourist Industry in the UK and AusWEA (2003) Wind Farms and Tourism
(7) http://www.offorsharp.com/downloads/baldhillseconomic.pdf

centre or information boards in order to maximise on the tourism potential of the project [1].

Some relevant positive experiences associated with selected wind energy facilities are provided in *Box 14.9*.

Box 14.9 Relevant Experiences of Selected Wind Energy Facilities

- **Altahullion Wind Facility** (Dungiven, Ireland) - local community groups requested tourist facilities at the site because of the influx of people visiting the facility. Developers persuaded the department of environmental service to provide tourist signage to guide visitors from the main road to the site. The site has a car park and specially designated turbine which people can walk to.

- **Beinn an Tuirc Wind Facility** (Argyll, Scotland) - this wind energy facility has established an open day where visitors can come visit the site. The site is so popular that the local government has been investigating the possibility of introducing a new bus route to take visitors to visit the facility.

- **Albany Wind Facility** (Albany, Western Australia) – this facility is considered by many to be a wonderful tourism attraction, so much so that it has been featured on television's Great Outdoors Show. Planning is underway for a Wind Discovery Centre at the Albany Wind Farm, with the aim of building a world class centre to attract additional tourists to the Albany region. According to the city's economic development statistics, traffic counters suggest about 100,000 people visited the wind facility last year (2005). Unbelievably the site is located near the ocean and the communities and fishermen have not complained about it as a deterrent.

Wind farms bordering national parks have been found to have a positive economic outcome for the parks and surrounding communities [2]. Visitors to the park usually visit the park and then take a detour to see the wind farm, and vice versa. There has been an increase in revenue generated at neighbouring national parks as tourists who were initially visiting the wind farm elected to visit the national park as well.

Construction Phase Impacts

The construction of the wind farm will result in noise, visual, traffic and a changed sense of place. These factors are unlikely to have any impact on tourism in the area due to the limited duration of the construction activities.

Operation Phase Impacts

Operation of the wind farm is predicted to have a negative impact on tourism-related activities in the area. This is in light of concerns raised in the stakeholder consultation process of the impact on the sense of place of the Richtersveld. Given that Renewable Energy Facilities are so new in South Africa, it is anticipated that people will travel to wind farm sites in order to view a development that has not yet been seen in our country, but it is

(1) Tim and Carmel Brady (2003) Wind Farms and Tourism, AusWEA,
(2) BWEA, (2006) Impact of Wind Farms on the Tourist Industry in the UK

unlikely that they will travel to the Richtersveld site due to its remoteness and the number of other wind farm developments proposed that are much more accessible.

Current tourism use is not direct in nature as there are no tourism facilities on the proposed project site. The site is, however, indirectly part of the tourism package of the broader area (the site will be visible for travellers along the R382). Changes to land use might have the potential to alter the tourist experience in the area. The responses of individuals will be subjective and dependent on their attitudes and perceptions as well as the purpose and pattern of their visit/interaction with the proposed Project. *Box 14.10* describes the operation impact on tourism activities.

Box 14.10 Operational Impact - Tourism Activities

Nature: The impact on tourism activities is most likely going to be a **direct, negative** impact.

Impact Magnitude – Low

- **Extent:** The impacts on tourism linked to the operational activities will occur at the **local** level.
- **Duration:** This impact will occur throughout the operational phase, and will therefore be **long-term**.
- **Intensity:** The intensity will be **low** as those who are directly affected will experience.

Likelihood – It is **unlikely** that this impact will occur during the operational phase. The R382 is not the most direct route to the Richtersveld thus it is not expected that many people will see the wind farm.

IMPACT SIGNIFICANCE (PRE-ENHANCEMENT) – NEGLIGIBLE

Degree of Confidence: The degree of confidence is **Low** given that there are no recorded experiences relating to similar developments in South Africa or other developing countries

14.5.2 Mitigation

The objective of mitigation is to minimise the negative impacts of the wind farm on tourism activities in the area.

Specific measures include:

- Apply all mitigation measures to reduce the noise and visual impacts as presented in Sections 11and 12).
- G7 will work with the Local Municipality and local tourism organisations to raise awareness about the wind farm.
- G7 will establish an information kiosk/notice board on the site boundary or entrance to facilitate educating the public about the need and benefits of project. This is aimed at instilling the concept of sustainability and creating awareness by engaging the community and local schools. Information brochures and posters will be made available at the kiosk to

provide more information about the facility. These should be presented in the appropriate languages to maximise the benefits.

14.5.3 Residual Impact

The implementation of mitigation measures for the operational phase of the Project will ensure that the impact remains of negligible significance. The pre- and post-mitigation impacts are compared in *Table 14.10*.

Table 14.10 Pre- and Post- Mitigation Significance: Tourism Activities

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Operation POSITIVE	**NEGLIGIBLE**	**NEGLIGIBLE**

14.6 SENSE OF PLACE

14.6.1 Impact Description and Assessment

Wind farms and their associated infrastructure can change the visual and acoustic character of an area by introducing large-scale structures and machinery into previously undeveloped areas, particularly in rural areas. This includes the wind turbines themselves, as well as electrical transmission lines, sub-station, maintenance staff, vehicles and maintenance equipment.

The proposed project site at Richtersveld is located in an area that is relatively disturbed. It lies alongside a Regional Road (R382) and between Port Nolloth and Alexander Bay. The farm is, however, extensive and extends away from these disturbed areas, thus becoming rural and isolated in parts.

Table 14.11 provides a summary of the sense of place impact.

Table 14.11 Impact Characteristics: Sense of Place

Summary	Construction	Operation
Project Aspect/ activity	Clearing and stripping of vegetation and topsoil for construction of Project infrastructure. Increased traffic. Visual and noise disturbances. Influx of workers and job-seekers.	Operation of wind farm and associated infrastructure - visibility of built structures, lighting, noise, operational traffic. Traffic slowing resulting from people looking at the facility.
Impact Type	Direct, negative impact (as related to project activities). Indirect, negative impact (as related to non-project activities e.g. influx of workers and jobseekers)	Direct, negative impact (as related to project activities). Indirect, negative impact (as related to non-project activities e.g. traffic slowing).
Stakeholders/ Receptors Affected	Directly affected landowners, neighbouring landowners, local communities, tourists, and drivers passing on the (R382).	Directly affected landowners, neighbouring landowners, local communities, tourists, and drivers passing on the (R382).

Construction Phase Impacts

During the construction phase, there will be a significant increase in the number of people (workers), noise generated, visual disturbances and traffic resulting directly from the construction activities. It is likely that there will also be an increase in the number of people as a result of an influx of job-seekers.

These factors are going to further disturb the area alongside the Regional Road and create disturbances to the areas located further from the road. The construction period is limited in time; as such, these disturbances should not continue for longer than 24 months. *Box 14.11* below describes the construction phase impact on the sense of place.

Box 14.11 Construction Impact: Sense of Place

Nature: The impact on sense of place is most likely going to be experienced as a **direct, negative** impact by the affected stakeholders.

Impact Magnitude – Low

- **Extent:** The impact on sense of place linked to the construction activities will occur at the **local** level.
- **Duration:** This impact will occur for the duration of the construction phase, approximately 24 months, and will therefore be **short-term**.
- **Intensity:** The intensity will be **low** as those who are directly affected will be able to adapt with relative ease; they are willingly participating in the Project.

Likelihood – It is **likely** that this impact will occur during the construction phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **high**.

Operation Phase Impacts

Given the already disturbed area in which the proposed Project will be located, there were limited concerns raised regarding the visual and noise impacts related to the facility. The directly affected landowners were not concerned about the transformed visual environment and did not think that the turbines would make much noise. They noted that the area is already very loud as a result of the close proximity of the road (R382) and the mining activities. The majority of receptors are unlikely to experience disruptions to the sense of place as they are located relatively far from the proposed project site. Those receptors that are passing through the area are mostly likely going to value the experience of viewing the wind farm en route to other destinations. *Box 14.12* below describes the operation phase impact on the sense of place.

Box 14.12 Operational Impact: Sense of Place

Nature: The impact on sense of place is most likely going to be experienced as a **direct, negative** impact by the directly affected stakeholders.

Impact Magnitude – Low

- **Extent:** The impact on sense of place linked to the operation activities will occur at the **local** level.
- **Duration:** This impact will occur for the duration of the operation phase and will therefore be **long-term**.
- **Intensity:** The intensity will be **low** as the wind farm is located in an isolated location away from sensitive receptors.

Likelihood – It is **likely** that this impact will occur during the operation phase.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR NEGATIVE

Degree of Confidence: The degree of confidence is **high**.

14.6.2 Mitigation

The objective of mitigation is to minimise, wherever possible, the impacts on sense of place by ensuring that all visual and noise impacts (amongst others) are addressed during construction and operation.

Specific measures include:

- Apply all mitigation measures to reduce the visual and noise impacts as presented in *Sections 11* and *12*).
- The construction activities will be undertaken in accordance with a schedule that will be approved by the landowners.
- All workers will agree to the Code of Conduct and be aware that contravention of the Code could lead to dismissal (as outlined in *Section 14.2*).
- All directly affected and neighbouring farmers will be able to lodge grievances with G7 using the Grievance Procedure as outlined in *Section 14.2*.

14.6.3 Residual Impact

The implementation of the above mitigation measures would reduce the construction and operation phase impacts from minor to negligible significance. The pre- and post-mitigation impacts are compared in *Table 14.12.*

Table 14.12 Pre- and Post- Mitigation Significance: Sense of Place

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (-VE)**	**NEGLIGIBLE**
Operation	**MINOR (-VE)**	**NEGLIGIBLE**

14.7 DISCUSSION

14.7.1 Unmet Stakeholder Expectations

During stakeholder consultation it was clear that there are high expectations around economic benefits (employment and procurement), community development and local electricity provision associated with the Project. Many of the stakeholder expectations will be met through routine project related activities (e.g. contract employment, procurement and skills development). Other expectations will be met through the community development fund. *Sections 14.1* provide more information about these benefits. It is however possible that the expectations may exceed the benefits delivered.

With regards to the provision of cheaper electricity to the project area, it is unlikely that G7 will be able to directly meet this demand. G7 is an independent power producer and is only allowed to sign a power purchase agreement with Eskom. The electricity produced at the facility will therefore be fed directly into the national electricity grid for distribution by Eskom. The presence of the wind farm and the sub-station would, however, make the possibility of electricity distribution in the area more accessible given the construction of the lower voltage transmission lines.

There is likely to be disappointment and potential anger and resentment if these expectations are not met. Unmet expectations that are not actively managed by G7 could have a negative impact on stakeholder relations.

14.7.2 Public Health and Safety

Public health and safety issues associated with wind energy projects are different from other forms of energy generation since a combustible fuel source, fuel storage, and generation of toxic or hazardous materials are not present. Wind energy projects do share similar electrical infrastructure requirements with conventional power generation facilities such as medium to high-voltage power lines and substation equipment. Unique concerns for wind turbines relate to the noise, shadow flicking, blade throw and fire hazards. As part of the environmental impacts chapters, these issues have been dealt with and therefore there is no need for a repeat discussion. Listed below are each of the issues/ concerns and the sections in the EIA where they are assessed:

- Noise/ infrasound: (noise study *Chapter 11*).
- Shadow flicker: (health and safety impacts *Chapter 15)*
- Blades throw: (health and safety impacts *Chapter 15*).

- Fire linked: (health and safety impacts *Chapter 15*).

15 OTHER IMPACTS

15.1 AIR QUALITY

This section considers the impacts to air quality during the construction and operation of the Richtersveld Wind Farm. Potential impacts likely to arise during the construction and the operational phases of the development are summarised in *Table 15.1*, below. It should be noted that development of wind-powered electrical generation, such as the proposed Richtersveld Wind Farm would result in an improvement to air quality by offsetting emissions created by fossil-fuel-burning power plants. However, during construction there may be short-term localized air quality impacts. Temporary, minor adverse impacts to air quality may result from the operation of construction equipment and vehicles. Impacts to ambient air quality are likely to arise from the following:

- dust generated during clearing of vegetation and by the preparation of site surfaces through earthworks;
- dust generated from vehicles on site travelling along unpaved access roads; and
- exhaust emissions from vehicles during construction.

Table 15.1 Impact Characteristics: Air Quality

Summary	Construction	Operation
Project Aspect/ activity	Vehicle movement on gravel / dirt roads. Soil disturbance and excavating. Emissions from construction vehicles and equipment.	Vehicle movement on gravel roads.
Impact Type	Direct negative	Direct negative
Stakeholders/ Receptors Affected	• Affected landowners • Road users • Construction personnel	• Affected landowners

Construction Phase Impacts

Dust-producing activities are likely to be more common during the early phases of construction, and mainly include site leveling (including blasting if required), the handling of spoil from leveling and clearing activities and vehicle movements. The Richtersveld site is accessed from the R382, a secondary public road to the west of the site, via a gravel road. Within the Richtersveld site, new and existing roads will be used to access the turbine locations. It is likely that dust generation will result from vehicles travelling along the access road and the site's internal road network.

The increased dust and emissions would likely not be sufficient to significantly impact local air quality. However increased dust can be a nuisance to site users, landowners and nearby receptors. Airborne dust could potentially be deposited on neighboring properties and vegetation in and around the site. In extreme cases, dust can cause respiratory problems for site users through inhalation, although this is not likely to occur at this site since construction activities will be progressive.

Dust becomes airborne due to the action of winds on material stockpiles and other dusty surfaces, or when thrown up by mechanical action, for example the movement of tyres on a dusty road or activities such as excavating. The levels of dust are expected to be highly variable and dependent on the time of year, the intensity of the activity and the prevailing winds at the time of construction. The quantity of dust released during construction depends on a number of factors, primarily:

- the type of construction activities occurring (e.g. crushing and grinding);
- volume of material being moved;
- the area of exposed materials;
- the moisture and silt content of the materials;
- distances travelled on unpaved surfaces; and
- the mitigation measures employed.

Dust emissions are exacerbated by dry weather and high wind speeds. During summer months, the area can be relatively dry and consequently, dust levels are high from the crop lands and track roads. The impact intensity of dust also depends on the wind direction and the relative locations of dust sources and receptors. There is potential for dust emissions during construction to impact on residential receptors or sensitive habitats, if these are within 200 m of an activity causing dust production. The stock posts located on the site would be potential receptors of dust impacts. However, given that the stock posts are sporadically occupied for temporary periods and they are located more than 200 m from the proposed turbine locations, it is not anticipated that they will be significantly impacted by dust. The R382 is over 3 km west of the site and it is not anticipated that there will be a dust impact resulting from construction activities for users of this road.

Box 15.1 Construction Impact: Dust

Nature: Site levelling, vehicle movement on farm and public roads and other construction activities that generate dust would result in a **negative direct** impact on receptors in the area.

Impact Magnitude – Low

- **Extent**: The extent of the impact is **local,** limited to within 200 m of construction activities, potentially impacting neighbouring farms.
- **Duration**: The duration would be **medium-term** for the 24 month duration of site preparation and construction.
- **Intensity:** Increased dust is unlikely to impact any sensitive receptors, due to the position of the receptors in relation to construction activities, therefore the intensity can be considered **low.**

Likelihood – There is a **definite** likelihood of dust generation from clearance of vegetation, earthworks and from vehicles travelling on the roads within and outside the site.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR

Degree of Confidence: The degree of confidence is **high**.

Minimal dust generation is expected to occur during the operational phase of the project by maintenance vehicles along the gravel access roads, which will be infrequent. Therefore, impact of dust generated during the operation phase is not considered any further.

15.1.2 Mitigation Measures

Inherent to the management of construction activities and to best practice in construction, typical dust mitigation measures will be put in place and are listed below. It should be noted, however that as the site is located in a water-scarce area, wetting of surfaces to minimise dust is not recommended during any phase of the development.

Construction phase

- Vehicles travelling on unpaved or gravel roads will not exceed a speed of 40 km/hr.
- Stockpiles of dusty materials will be enclosed or covered by suitable shade cloth or netting to prevent escape of dust during loading and transfer from the site.
- Vehicles are to be kept in good working order and serviced regularly to minimise emissions.
- All directly affected and neighbouring farmers and local residents will be able to lodge grievances with G7 using the Grievance Procedure (included in the EMP) regarding dust emissions that could be linked to the Project.

Operation phase

- Vehicles travelling on unpaved or gravel roads should not exceed a speed of 40 km/hr.

15.1.3 Residual Impacts

Impacts from dust and emissions are anticipated to be negligible during the operational phase. Impacts related to an increase in dust during the site preparation and construction phase will remain at minor should suggested mitigation be implemented.

Table 15.2 Pre- and Post- Mitigation Significance: Richtersveld Wind Farm – Dust and Emissions

Phase	Pre-mitigation Significance	Residual Impact Significance
Construction (dust)	**MINOR (-VE)**	**MINOR (-VE)**
Construction (emissions)	**NEGLIGIBLE**	**NEGLIGIBLE**
Operation (dust & emissions)	**NEGLIGIBLE**	**NEGLIGIBLE**

15.2 TRAFFIC IMPACT

Potential impacts to traffic and road users likely to arise during the construction and the operational phases of the Richtersveld Wind Farm are summarised in *Table 15.3*, below.

Table 15.3 Impact Characteristics: Traffic

Summary	Construction	Operation
Project Aspect/ activity	Delivery of turbine components and construction equipment. Delivery of concrete. Construction personnel commuting to and from site.	Operational personnel commuting to and from site. Delivery of replacement turbine components.
Impact Type	Direct negative	Direct negative
Stakeholders/ Receptors Affected	• Road users • Affected landowners	• Road users • Affected landowners

Construction Phase Impacts

During the construction phase of the Richtersveld Wind Farm, there would be an increase in vehicle movement to and from the site. This has the potential to impact on traffic along the transport route and within the site boundaries. It is assumed that wind turbine components and other equipment would be brought in by road freight, from the Port of Cape Town or the Port of Saldanha, depending on capacity and accessibility at the time of construction. The site is accessed via the N7 National road and the R382, a secondary public road. The preferred access road to the site intersects with the R382. A transport study would be undertaken approximately one year prior to the commencement of construction, in order to determine the most appropriate route to transport the equipment from the selected port to site.

The turbines and other construction materials would be delivered to site on low-bed trucks. The trucks delivering turbine components would be considered to be carrying abnormal loads in terms of the Road Traffic Act (Act No 29 of 1989). Approximately eight truck loads would be required per turbine:

- One for the nacelle;
- Three for the turbine tower;
- One for the spinner and hub; and
- Three for the blades.

Up to 600 vehicles would be required to deliver the wind turbine components for the 75 proposed turbines in Site Alternative 1. This represents a worse case scenario, as there are 69 turbines proposed for Site Alternative 2. Other heavy vehicle deliveries would be required to transport cables, machinery and construction material for the proposed hard standing area and substation.

An on-site batching plant is likely to be developed (subject to the appropriate permits) to mix concrete onsite. In addition, G7 will require aggregate material that is likely to be sourced from opening one or more new borrow pits on site. The presence of an on-site batching plant and borrow pit would minimize the number of vehicle movements required to and from the site. In the event that a batching plant is not developed, each foundation would take between 80 and 90 loads of concrete (assuming each load is approximately 6 m^3), resulting in approximately eight deliveries per hour for a day for each turbine foundation.

It is estimated that approximately 111 local construction jobs would be created for the duration of the construction phase and it is anticipated that some of the workers will stay in a construction camp on site, while others would travel to and from the site daily during the construction period. The construction phase of the project would take approximately 24 months and during this time increases in traffic levels would be intermittent and temporary in nature.

Public roads may need to be upgraded to facilitate the transport of the turbines and other construction materials to the site. Typically, roads for transporting the turbines would need to be up to 12 m wide including drainage trenches and cabling, and possibly wider for short sections of the road to enable the turning and passing of vehicles, and to accommodate short bends. This is given that the road is relatively straight with no sharp bends. The exact final road width as well as method/equipment used for civil works will be determined during detailed civil engineering and transportation planning. Upgrade works will result in an increased volume of traffic along the final transport route causing disturbance or disruption to local road users of the secondary roads.

The increase in traffic, especially from heavy loads, could create noise, dust and safety impacts for other road users and people living or working within

close proximity to the roads selected as transport route. In addition, the increased volume of traffic along the final transport route would increase the wear and tear on these roads and possibly lead to deterioration in road conditions.

The area around the Richtersveld site is used by the Nama for herding live stock in a traditional manner, therefore, there are no fences or stock camps on site and there is a risk of collision with live stock. However, this risk can be mitigated as described in *Section 15.2.2*.

Box 15.2 Construction Impact: Richtersveld Wind Farm – Traffic

Nature: Vehicles required for the transport of infrastructure (e.g. turbines and cables) and materials would result in a **negative direct** impact on the roads used and road users.

Impact Magnitude – Medium-low

- **Extent**: The extent of the impact is **regional** as the potential impact will extend along the selected transport route.
- **Duration**: The duration would be **short-term** for the duration of construction, up to 24 months.
- **Intensity:** The intensity is likely to be **medium** given that the increase in traffic would be temporary, but may create a nuisance and impact on the safety of other road users.

Likelihood – There is a **definite** likelihood of increased traffic.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)

Degree of Confidence: The degree of confidence is **medium** as the exact number of vehicles visiting the site is not known.

Operation Phase Impacts

There would be a dedicated operations team comprising 39 full time personnel operating the facility. These employees would have to commute to and from the site on a daily basis. Maintenance staff would visit the site several times a month requiring one or two vehicles. In addition, infrequent deliveries of replacement parts may be made during the lifespan of the Wind Farm. Potential traffic impacts associated with the operation of the facility would be largely limited to the site and the local access road, therefore having the potential to impact the farm owners and users of the access roads to the site and the road network on the site.

Box 15.3 Operation Impact: Richtersveld Wind Farm – Traffic

Nature: Increased traffic from workers travelling to and from the site would result in a **negative direct** impact on people who use the access roads to the site, and the road network used on the site.

Impact Magnitude – Low

- **Extent**: The extent of the impact is **local** as the impact would be restricted to the immediate vicinity of the site.
- **Duration**: The duration would be **long-term** for the operation of the Wind Farm, up to 25 years.
- **Intensity:** The intensity is likely to be **low** given that the increase in traffic would be minimal.

Likelihood – There is a **definite** likelihood of increased traffic in the area surrounding the site and on site.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **high.**

15.2.2 Mitigation Measures

Design

- A transport study will be undertaken approximately one year prior to the commencement of construction to determine the most appropriate route from port to site. All necessary transportation permits will be applied for at this stage;

- G7 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; and

- G7 to 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.

Construction

- 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;

- All construction vehicles must adhere to a speed limit of 40km/h and obey all road signs when using the internal roads; and

- All directly affected and neighbouring farmers and local residents must be able to lodge grievances with G7 using the Grievance Procedure (see the EMP in *Annex L*) regarding dangerous driving or other traffic violations that could be linked to the project.

Operation

- All maintenance vehicles must adhere to a speed limit of 40km/h and obey all road signs when using the internal roads; and
- During operation, if abnormal loads are required for maintenance, the appropriate arrangements must be made to obtain the necessary transportation permits and the route agreed with the relevant authorities to minimise the impact on other road users.

15.2.3 Residual Impacts

Impacts from an increase in traffic during the construction and operational phase would be reduced to minor and negligible respectively should the proposed mitigation measures be implemented.

Table 15.4 Pre- and Post- Mitigation Significance: Richtersveld Wind Farm - Traffic

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MODERATE (-VE)**	**MINOR (-VE)**
Operation	**MINOR (-VE)**	**NEGLIGIBLE**

15.3 WASTE AND EFFLUENT

This section focuses on the potential impacts associated with waste and effluent generated during the construction and operational phases of the Richtersveld Wind Farm development.

15.3.1 Impact Description and Assessment

The project would lead to the generation of several wastes streams. *Table 15.5* identifies the origin of waste and effluent associated with the construction and operational phases of the Richtersveld Wind Farm and the stakeholders or receptors likely to be affected.

Table 15.5 Impact Characteristics: Waste and Effluent

Summary	Construction	Operation
Project Aspect/ activity	Waste and/or effluent originating from: construction activities including excavation, unpacking of turbine equipment, general eating facilities on site and general office facilities.	Waste and/or effluent originating from: maintenance activities and general office facilities.
Impact Type	Direct negative	Direct negative
Stakeholders/ Receptors Affected	• Affect land owner • Surrounding habitat	• Affect land owner • Surrounding habitat

Construction Phase Impacts

Inevitably, the construction of the Wind Farm would result in the production of a variety of waste streams being generated. During site clearance and

levelling, solid waste would be generated from vegetation clearance and soil overburden. Construction rubble would be produced throughout the construction phase from activities such as the construction or upgrade of access roads, laydown and maintenance areas, the new substation facility and concrete pouring. Packaging material would be accumulated from unpacking of turbine equipment and off cuts would be produced through various construction activities. General waste would be produced by site personnel including wrapping from food, bottles and cans. Effluent would be produced from toilet facilities (temporary chemical toilets) which would be located onsite for construction workers.

It is anticipated that waste and effluent would be temporarily stored on site before it is removed by an appropriate contractor. There is potential for waste and effluent stored on site to leach into the soil and/ or groundwater, causing harm to the natural environment and potentially contaminating the soil and/ or groundwater. There is a risk that silt and wash water could enter the drainage lines on site.

Box 15.4 Construction Impact: Richtersveld Wind Farm Waste and Effluent Pollution

Nature: Construction activities that produce waste and effluent would result in a **negative direct** impact on the site.

Impact Magnitude – Low

- **Extent**: The extent of the impact is **onsite** as impact would be restricted to the site.
- **Duration**: The duration would be **short-term** as impacts could persist after the construction of the Wind Farm.
- **Intensity:** The intensity is likely to be **low** as the construction phase is temporary and the site is not inhabited.

Likelihood – It is **unlikely** that waste and effluent generated on site will impact on the soil and/ or groundwater and other site users.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **high.**

Operation Phase Impacts

General waste, such as office waste, and effluent from onsite toilet facilities would be produced during the operation phase of the Wind Farm by onsite personnel. However, this would be limited as there is only likely to be up to 49 permanent personnel on site and a small team of personnel expected during maintenance activities (see *Chapter 4*).

Maintenance activities may result in the collection of used oil and hydraulic fluid, it is anticipated that this will be temporarily stored on site before being removed by an appropriate contractor. Waste produced during the operation phase would be minimal.

Box 15.5 Operation Impact: Richtersveld Wind Farm Waste and Effluent Pollution

Nature: Operation activities that produce waste would result in a **negative direct** impact on the site.

Impact Magnitude – Low

- **Extent**: The extent of the impact is **onsite** as impact would be restricted to the site.
- **Duration**: The duration would be **long-term** during the operation of the Wind Farm which will be up to 25 years.
- **Intensity:** The intensity is likely to be **low** as all oils and hydraulic fluids and waste from toilet facilities would be carefully managed and the onsite activities would be limited.

Likelihood – It is **unlikely** that small quantities of spilled oil and hydraulic fluid and small quantities of general waste generated on site from the 20 or so permanent personnel would cause soil or water pollution.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **high.**

15.3.2 Mitigation Measures

The potential impacts associated with the generation of waste and effluent can be minimised through careful mitigation measures, as described below.

Design

- A suitable area for waste skips must be selected, away from water courses, and included in the site layout plan.

Construction

- All waste must be separated into skips for recycling, reuse and disposal;
- 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;
- Effluent from temporary staff facilities must be collected in storage tanks, which must be emptied by a sanitary contractor;
- Effluent from concrete washings from the on-site batching plant must be contained within a bunded area;
- All solid and liquid waste materials, including any contaminated soils, must be stored in a bunded area and disposed of by a licensed contractor;
- Effluent and stormwater run-off must be discharged away from any water courses;
- Steel off-cuts must be re-used or recycled, as far as possible; and

- Materials that cannot be re-used or recycled must be placed in a skip and removed from site to a licensed municipal disposal site.

Operation

- Used oil stored on site must be stored in an impervious container, within a bunded area; and

- General waste must be removed from site by a licensed contractor.

15.3.3 Residual Impacts

If mitigation measures given above and listed in the EMP are implemented, the overall significance would remain low during the construction phase and negligible during the operational phase of the Richtersveld Wind Farm as outlined in *Table 15.6* below.

Table 15.6 Pre- and Post- Mitigation Significance: Richtersveld Wind Farm – Waste and Effluent

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (-VE)**	**MINOR (-VE)**
Operation	**MINOR (-VE)**	**NEGLIGIBLE**

15.4 HEALTH AND SAFETY LINKED TO CONSTRUCTION AND OPERATION ACTIVITIES

Potential impacts on construction and operational personnel, and road users likely to arise during the various phases of the Richtersveld Wind Farm development are summarised in *Table 15.7* below.

Table 15.7 Impact Characteristics: Health and Safety

Summary	Construction	Operation
Project Aspect/ activity	Construction activities	Operational activities
Impact Type	Direct, negative impact	Direct, negative impact
Stakeholders/ Receptors Affected	Construction personnel	Landowner, other site users, onsite personnel.

Construction Phase Impacts

Construction activities would involve working with heavy machinery and large turbine components. During the construction phase there would be open excavation and possibly borrow pits on site, heavy vehicles moving on site and large, heavy components would need to be moved across the site, and lifted by a crane. These construction activities are potentially dangerous if not managed appropriately.

There is also potential for construction activities to cause driver distraction amongst road users. The large scale of the construction equipment used to install the wind turbines, together with the unfamiliar sight of such construction may attract driver curiosity and attention.

Box 15.6 Construction Impact: Richtersveld Wind Farm - Health and Safety

Nature: The impact on health and safety would be a **direct negative** impact.

Impact Magnitude – Low

- **Extent:** The health and safety risks linked to the construction activities would occur at the **local** level.
- **Duration:** This impact will be for the construction phase, and would therefore be **short-term**.
- **Intensity:** The intensity would be **low** as those who are directly affected would (in most cases) be able to adapt.

Likelihood – It is **unlikely** that accidents would happen on site during the construction phase as potential accidents can be mitigated through a health and safety plan. It is **likely** that road users may become distracted by the sight of turbines being transported along the public roads.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **Medium.**

Operation Phase Impacts

It is recognised that the wind turbines may cause driver distraction among road users where the wind turbines are visible from a public road. This is particularly the case given that there are few commercial wind farms operating in South Africa at present, and the wind farm would be a novelty to many road users. The wind turbines would be visible from the R382 approximately 3 km west of the site. Based on the findings of the visual impact assessment (see *Chapter 12*), it is clear that drivers on the R382 would be able to see the turbines from a distance of approximately 10 km and they would gradually become clearer and more visible the closer one moved toward the Richtersveld Wind Farm. Driver distraction is more severe if the driver cannot see the wind farm upon approach, and as they come around a visual barrier (such as a corner or rise), the wind farm suddenly becomes visible. This is not the case with this site given the flat terrain.

During the operation phase there is a danger of turbine failure, which may occur for a number of reasons. One of the most common causes of turbine failure is gear box failure, which can lead to a fire given the flammable nature of the composites used to make the turbines. Structural failure may result in the turbine collapsing or a blade becoming detached and flying off the structure, this is known as "blade throw." If a turbine were to collapse onto a structure or road it could cause damage to property or harm to persons in the immediate vicinity. Modern wind turbines are fitted with electronic monitoring systems within the transmission system to reduce the risks of mechanical failure.

Box 15.7 Operational Impact: Health and Safety

Nature: The impact on health and safety would be a **direct negative** impact.

Impact Magnitude – Low

- **Extent:** The health and safety risks linked to the operational activities would occur **on-site**.
- **Duration:** This impact will occur throughout the operational phase, and would therefore be for the **long-term**.
- **Intensity:** The intensity would be **low** as damage or injury from turbine failure can be mitigated.

Likelihood – It is **likely** that drivers would suffer 'driver distraction' during the operational phase, however given that turbine construction would meet manufacturers specifications, failure of the turbines in **unlikely**.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)

Degree of Confidence: The degree of confidence is **high**.

15.4.2 Mitigation

The objective of mitigation is to manage construction and operation so that impacts on health and safety risks to local residents, contractors, employees and animals are reduced.

Design

- Turbines must be spaced at least a turbine and a half's distance from one another so that if one turbine collapses, it does not make contact with the nearest turbine.

Construction

- 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); and

- Appropriate Personal Protection Equipment (PPE) must be worn by all construction personnel.

Operation

- Regular maintenance of turbines and all other infrastructure must be undertaken to ensure optimal functioning and reducing the chance of gearbox failure; and

- Regular inspections of the turbine foundations, towers, blades, spinners and nacelle must be undertaken in order to check for early signs structural fatigue.

15.4.3 Residual Impact

The implementation of the above mitigation measures would reduce the construction and operation impacts from minor to negligible. The pre- and post-mitigation impacts are compared in *Table 15.8*.

Table 15.8 Pre- and Post- Mitigation Significance: Health and Safety

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**MINOR (-VE)**	**NEGLIGIBLE**
Operation	**MINOR (-VE)**	**NEGLIGIBLE**

15.5 SHADOW FLICKER

15.5.1 Impact Description and Assessment

Under certain light conditions the moving shadow cast by revolving wind turbine blades can result in a flickering effect. This transient effect is known as shadow flicker and is experienced on the ground or inside dwellings with narrow aperture windows when the direction and angle of incident sunlight align. Shadow flicker is not a concern during the construction phase as it only has the potential to occur during operation of a Wind Farm.

Table 15.9 Impact Characteristics: Shadow Flicker

Summary	Construction	Operation
Project Aspect/ activity	N/A	Operation of wind turbines
Impact Type	N/A	Direct negative
Stakeholders/ Receptors Affected	N/A	Affected landowners or those living on site

Operation Phase Impacts

Shadow flicker can be a nuisance, particularly when the receptor is in a building, as the contrast between light and shade is most noticeable through windows and doors. Flickering and strobing can potentially trigger an epileptic fit in cases of photosensitive epileptic. A survey carried out by Epilepsy Action (1) in the UK, concluded that wind turbines may create circumstances where photosensitive seizures can be triggered, however it does appear that this risk is minimal. Furthermore they state that "*newer wind turbines are usually built to operate at a frequency of 1 Hz or less. These flicker rates are unlikely to trigger a seizure.*" (2)

(1) Epilepsy Action online, available at http://www.epilepsy.org.uk/campaigns/survey/windturbines
(2) Epilepsy Action online, available at http://www.epilepsy.org.uk/info/photosensitive/triggers

The following physical circumstances need to apply simultaneously before shadow flicker can occur:

- the receptor must be within 10 turbine diameters of the turbine;
- there must be a sufficient level of sunlight;
- the wind turbine must be operating (wind speeds must therefore be at least about 2.5m s^{-1});
- the moving shadow cast by rotating blades must be seen from within a building, particularly when viewed through a narrow window;
- the orientation of the turbine and its angle of elevation to the observer must coincide with the angle and the position of the sun in relation to the building so that the shadow falls onto the receptor; and
- since the origin of the effect is the sun, receptors that may be affected must lie to the south of the point where the sun rises and sets.

Where these circumstances pertain, the exact position of shadows can be calculated very accurately for each sensitive location for the key times of day and year to determine the potential for shadow flicker. The turbine diameter for the proposed Wind Farm would be approximately 117 m. A receptor would therefore need to be within 1170 m from the turbine to experience shadow flicker.

There are no farm houses on the Richtersveld site, but there are at least three stock-posts within 1.17 km of the turbines. The stock posts may be temporarily occupied at various different times of the year, however, given the nature of the use the stock-posts, it is not anticipated that the herders using them will be impacted by shadow flicker. The site is located approximately 3 km from the R382, therefore, road users will not experience shadow flicker on the road.

Box 15.8 *Operational Impact: Shadow Flicker*

Nature: The impact of shadow flicker would be a **direct negative** impact on people within dwellings.

Impact Magnitude – Medium

- **Extent:** The shadow flicker would occur at the **onsite** level, as this impact would impact people within stock posts located within a 1.17 km radius of the proposed turbines.
- **Duration:** This impact would be **long-term** throughout the operational phase of the Wind Farm, 25 years.
- **Intensity:** The intensity would be **medium** at the affected stock-posts since they are not permanently occupied.

Likelihood – It is **likely** that this impact could occur at three stock posts during the operational phase, as they are located within 1.17 km from the proposed turbine locations.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE

Degree of Confidence: The degree of confidence is **medium** as the exact locations of the proposed turbines have not as yet been micro-sited.

15.5.2 Mitigation

Should shadow flicker be identified as a problem at any of the stock-posts on site, G7 will under take the necessary measure to mitigate this impact. Mitigation may include re-siting the impacted stock-posts or planting indigenous trees to provide screening in front of windows or doors.

Table 15.10 *Pre- and Post- Mitigation Significance: Shadow Flicker*

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Operation	MODERATE	MINOR

15.6 ELECTROMAGNETIC INTERFERENCE

Electromagnetic interference is not a concern during the construction phase and can only occur during the operation of the Wind Farm, when the turbines are in operation. Note: Some information gaps exist that will only become available once a final supplier has been identified.

Table 15.11 *Impact Characteristics: Electromagnetic Interference*

Summary	Construction	Operation
Project Aspect/ activity	N/A	Operation of the wind turbines
Impact Type	N/A	Direct negative
Stakeholders/ Receptors Affected	N/A	Users of communication systems

Operation Phase Impacts

Operating wind turbines can cause electromagnetic interference (EMI). This can potentially affect communication systems including TV, radio and mobile phone transmitters, microwave links, radar and aircraft navigation beacons.

For broadcast systems, such as television, a wind farm located between a television transmitter and a receiver aerial may cause loss of picture detail, loss of colour or buzz on sound. Viewers situated to the side of a wind farm may experience a delayed image or 'ghost' on the picture, liable to flicker as the blades rotate. In some cases, a wind farm can also affect the re-broadcast link (RBL) feeding the transmitter.

Broadcast radio transmissions are received at radio receivers after radio signals have travelled through free space and often through structures. Because of this method of transmission and reception, it can be concluded that the proposed wind farm would have no detrimental effects on national or local radio in the vicinity of the proposed development.

There is the potential for rotating turbine blades to generate unwanted returns on air traffic control and defence radar displays. This may affect wind turbine developments as much as 75 km away from a radar site.

The potential for interference is dependent on the positions of turbines in relation to incoming or outgoing signals as well as the specific characteristics of the signal. In addition, the nature of the material of the turbine rotors would result in impacts of varying magnitude i.e. those constructed of composite materials which have reduced potential for signal interference in comparison with metal blades. Following advice from ERM, G7 has identified potential interested and affected parties and consulted with them in order to identify the potential impacts associated with electromagnetic interference at and around the Richtersveld site. The following service providers have been consulted with:

- Department of Defence;
- Eskom;
- MTN;
- SA Police;
- Sentech;
- Transnet;
- Telkom; and
- Vodacom.

To date, these service providers consulted have not highlighted any serious concerns although some are currently undertaking their own studies and awaiting results. G7 are aware that the possibility of interference although not expected to be an issue, can not be ruled out. During the operational phase, should interference occur, G7 will establish procedures to investigate any complaints of interference through an effective Grievance Procedure (See *Section 14*). G7 have committed to correct any EMI impacts if it is shown that the Wind Farm is responsible.

15.7 CLIMATIC EFFECTS

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. ERM has undertaken further extensive research for peer reviewed studies assessing and evaluating potential impacts on micro- and regional climate from wind farm developments. In excess of 15 key authors in this field of research were established and research studies interrogated. The research study articles are referenced in Chapter 19. (These studies do not include potential positive impacts related to reduced carbon production and prevention of global warming effects in the simulation models, however, reference is made that such potential positive impacts is not to be ignored or overlooked).

The generation of electricity using wind turbines is percentage-wise the fastest growing energy resource globally among current energy technologies with low or zero greenhouse gas (GHG) emissions (Wang and Prinn, 2010). Most of this growth is in the industrial sector, based on large utility-scale wind farms. Debates exist regarding the global-scale effects of wind farms, however, modelling studies indicate that wind farms can affect local-scale meteorology (Baidya Roy and Traiteur, 2010).

Solar energy absorbed by the Earth is converted into various forms of energy; namely latent heat (by evaporation), gravitational potential energy (by atmospheric expansion), internal energy (by atmospheric and oceanic warming, condensation) or kinetic energy (such as convective and baroclinic instabilities). If averaged globally, total atmospheric energy is comprised of the following percentages:

- Internal energy – 70.4 percent
- Gravitational potential energy – 27.05 percent
- Latent heat – 2.5 percent
- Kinetic energy – 0.05 percent

Of the already relatively lower percentage of kinetic energy, only a small fraction is contained in the near surface winds that produce small-scale turbulent motions due to surface friction. These turbulent motions further downscale to molecular motions, and thus convert bulk air kinetic energy to internal energy. However, in considering the question of potential climatic impacts from wind farms, it is not the size of these energy reservoirs, but rather the rate of conversion from one to another that is more relevant. According to Wang and Prinn's (2010) model calculations, the global average rate of conversion of large-scale wind kinetic energy to internal energy near the surface is approximately 1.68 W/m^2 (860 TW globally). This only constitutes approximately 0.7 percent of the average net incoming solar energy of 238 W/m^2 (122 PW globally). The magnitude of this rate in the presence of wind turbines is expected to differ, but not by large factors (Wang and Prinn, 2010).

Wind turbines function by converting wind power into electrical power. Turbulence near the surface, however, also feeds on wind power. This turbulence is critical for driving the heat and moisture exchanges between the surface and the atmosphere, which play an important role in determining surface temperature, atmospheric circulation and the hydrological cycle (Wang and Prinn, 2010). The rate of energy extraction by wind farms from the atmosphere (approximately 1 W/m^2), although small compared to the kinetic and potential energy stored in the atmosphere, is comparable to time-tendency terms, for example the rate of conversion of energy from one form to another and frictional dissipation rate in the atmospheric energy balance equation. This indicates that influence to atmospheric and surface processes by wind farms is possible (Baidya Roy et al., 2004).

15.7.1 Potential Impacts on Local Climate

In a modelling study conducted by Baidya Roy et al. (2004), results indicated that the modelled wind farm significantly slowed down the wind at the turbine hub-height level. In addition to this, the turbulence generated in the wake of the rotors create eddies that can enhance vertical mixing of momentum, heat and scalars, usually leading to a warming and drying of the surface air and reduced surface sensible heat flux. The effect was found to be most intense during the early morning hours when the boundary layer is stably stratified and the hub-height level wind speed is the strongest due to the nocturnal low-level jet. The impact on evapotranspiration was found to be small.

A recent study conducted by Baidya Roy and Traiteur (2010), using field data and numerical experiments with a regional climate model, potential impacts of wind farms on surface air temperatures was investigated. Data showed that near-surface air temperatures downwind of the wind farm are higher than upwind regions during night and early morning hours, while the reverse held true for the rest of the day. Therefore the wind farm investigated has a warming effect during the night and a cooling effect during the day. Baidya Roy and Traiteur (2010) proposed an explanation for this using the hypothesis put forward in the Baidya Roy et al. (2004) work, that turbulence generated in the wake of the rotors enhance vertical mixing. Under stable atmospheric conditions when the lapse rate is positive, i.e. a warm layer overlies a cool layer, the enhanced vertical mixing mixes the warm air down and cooler air up, leading to a warming near the surface. While under unstable atmospheric conditions with a negative lapse rate, i.e. cool air lying over warmer air, the turbulent wakes mix cool air down and warm air up, thereby producing a cooling effect near the surface. The atmospheric model used supported the field data findings. The model simulations additionally indicated that the temperature change in wind farms was also a function of the mean ambient hub-height (second atmospheric layer) wind speed. Weaker impacts were found at higher wind speeds. Two factors may lead to this. Firstly, at wind speeds higher than 20m/s the rotors are designed to stop working. If average wind speed is high, it is likely that instantaneous wind speeds frequently exceed 20m/s, hence the rotors work only intermittently, reducing the mean

impacts on the surface temperatures. Secondly, at high wind speeds the ambient turbulence is also relatively high, resulting in lower impacts.

Baiyda Roy and Traiteur (2010) state that as many of the wind farms are located on agricultural land, the impacts from wind farms on surface meteorological conditions are likely to affect agricultural practices, in some cases the impacts may be beneficial such as the nocturnal warming under stable atmospheric conditions protecting crops from frost. They additionally state that if the wind farms are sufficiently large, they may also effect downstream surface meteorology.

In response to the Baiyda Roy and Traiteur (2010) study, Bruce Bailey of AWS Truepower states that turbines in use today are technologically more advanced than the ones used in the study and differ in dimensions. Additionally, the spacing between turbines is different, currently being spaced at least five times wider apart than those used in the study. Wind developers are already taking the temperature effect into account because of the impact of the 'upstream' turbines buffeting the wind on 'downstream' turbines. Seemingly many wind farm projects map multiple weather data, including temperatures, and are aware of this effect (Biello, 2010).

Baiyda Roy and Traiteur (2010) put forward two options for reducing the above mentioned effects. One option is to have turbines designed to reduce the turbulence generated by the rotors. Rotors that generate more turbulence in their wakes are likely to have a stronger impact on near-surface air temperatures. The second option is to look for optimal siting solutions for wind farms. Taking their study findings into consideration, the impact of wind farms starts decreasing sharply as ambient surface kinetic energy dissipation rate becomes larger than 2.7 W/m^2 and becomes almost zero at dissipation rates higher than 6 W/m^2. Therefore, generally, the more turbulent the site is naturally, the lower the potential impact on surface temperatures by an introduced wind farm. As Biello (2010) states, it is in these naturally turbulent areas that wind farms tend to be located, as that is often where the wind is strongest.

15.7.2 Potential Impacts on Global Climate

There is currently a debate regarding the potential effects of large-scale wind farms on climate at a global scale. A study of climate –model simulations that addresses the possible climatic impacts of wind power at regional to global scales by using two general circulation models and several parameterizations of the interaction of wind turbines with the boundary layer by Keith et al. (2004) found that large-scale use of wind farms can alter local and global climate by extracting the kinetic energy and altering turbulent transport in the boundary layer. The study found that very large amounts of wind farm power generation can produce 'nonnegligible' climatic change at continental scales. However, although large-scale effects are observed, the overall effect on global-mean surface temperature is negligible.

Barrie and Kirk-Davidoff's (2010) General Circulation Model study, representing a continental-scale wind farm as a distributed array of surface roughness elements, showed that the extensive installation of wind farms would alter surface roughness and significantly impact the atmospheric circulation due to the additional surface roughness forcing. The model showed that disturbances caused by a step change in roughness grew within four and a half days, such that the flow is altered at synoptic scales. The authors recognize that wind farms on this scale do not exist, and as such view the work as a theoretical problem, with real applications in decades to come.

A further study conducted by Wang and Prinn (2010), using a three-dimensional climate model simulating the potential climate effects associated with the installation of wind turbines over large areas of land or coastal ocean, showed that in meeting 10 percent or more of the global energy demand in 2100 (approximately 140 EJ/year (4.4TW)), surface warming exceeding 1°C over land could be caused. While in contrast, surface cooling exceeding 1°C was computed over ocean installations. Significant warming or cooling remote from the land and ocean installations, and alterations of the global distributions of rainfall and clouds also occurred in the model simulations.

The obvious critique of the above studies is that they are purely theoretical and based on simulation models. These models are dependent on the accuracy of the model used and the realism of the methods applied in order to simulate the wind turbines (Wang and Prinn, 2010). Baiyda Roy in considering the question of climatic impacts on a global scale remains sceptical, stating that a subsequent study awaiting publication, indicates that these climatic impacts are restricted to a small area around the wind farms. Additionally stating that although the above studies indicate large scale wind farms having global climatic effects, if the wind farms are spaced sufficiently apart, they will not cause global scale effects (Baiyda Roy in Biello, 2010).

It should be noted that preliminary calculations using assumptions common in the models used by Keith et al. (2004), consistently show that by reducing CO_2 emissions, the indirect benefits of wind farms exceed the costs (or benefits) of use from their direct climatic effects. Therefore the greatest potential climatic impact on a global level may be the reduction of CO_2 in the atmosphere.

15.7.3 Conclusions

Modelling studies on the cumulative climatic effects of wind farms over entire countries or regions are inconclusive. On a local scale, only one known published modelling study has been supported by data collected in the field, but 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. It is not clear whether these changes are likely to have significant or noticeable impacts on local climatic conditions and site

specific conditions are likely to play a major role in whether micro-climatic effects may occur.

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. This should not be coordinated by G7 but by a research institute. Although such research falls beyond the scope of this EIA, G7 could possibly provide support to such a study. In order to contribute to longer term understanding, certain climatic data should be collected on site and at a control site to assist with interpreting additional data that is collected.

16 CUMULATIVE IMPACTS

Cumulative impacts are impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the project under consideration (e.g. the combined effect of other similar projects in the general area. An impact to a resource in itself may not be considered significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse developments 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 DEA 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;
- 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 the Richtersveld site 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.

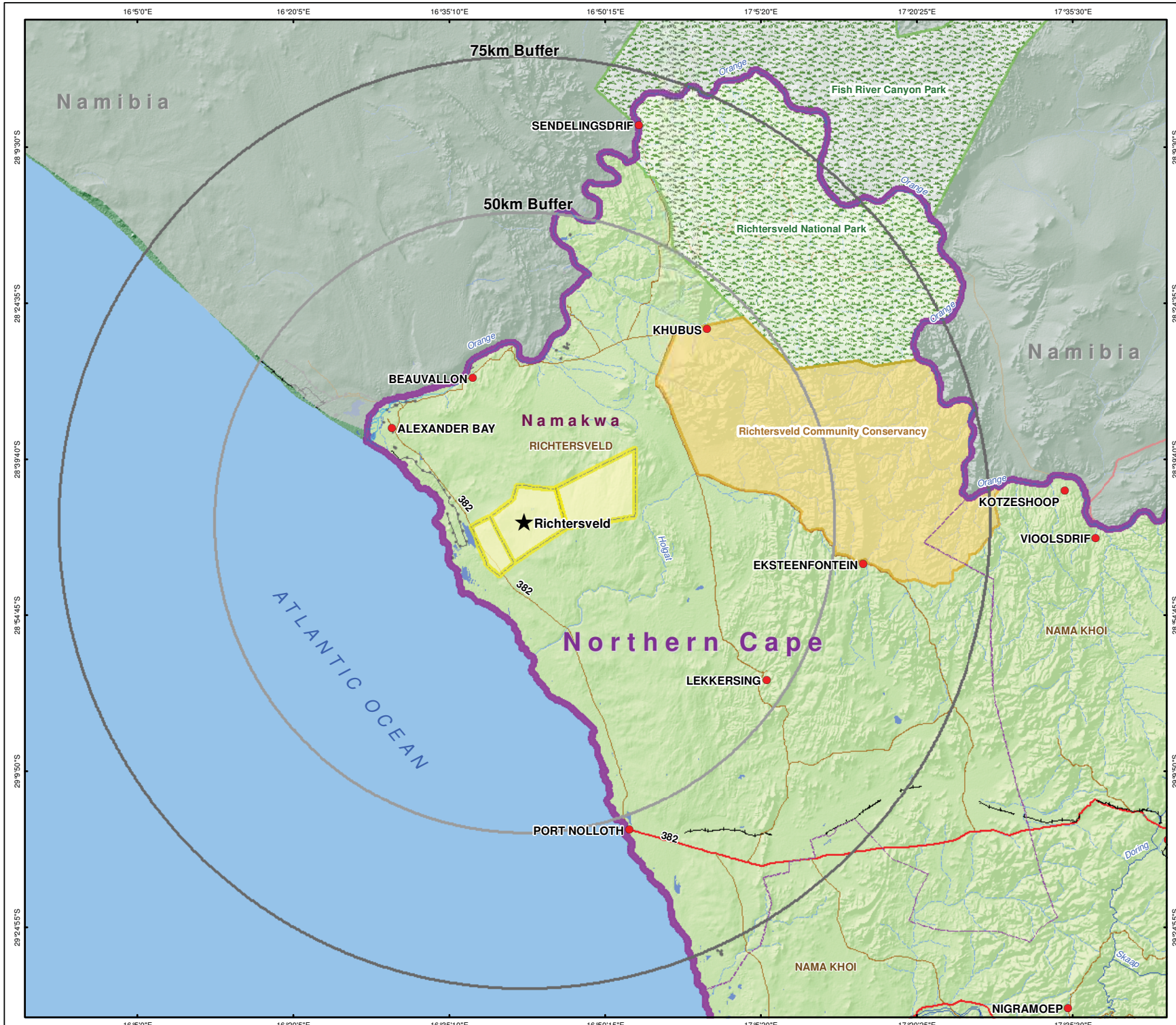
16.1 APPROACH TAKEN TO ASSESS CUMULATIVE IMPACTS

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 Richtersveld Wind Farm and other known developments will be qualitatively assessed in this Chapter. *Figure 16.1* shows the proposed location of the Richtersveld 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.



Legend

- Towns
- Provincial Boundaries
- Northern Cape
- Namibia
- District Municipalities
- Local Municipalities
- Transmission Line
- Main Road
- Secondary Road
- Railway
- Perennial River
- Non-Perennial River
- Inland Water
- National Park
- Richtersveld Land Parcel

SCALE:

0 5 10 15 20 25 30

Kilometres

N

TITLE:

Figure 16.1: Planned Renewable Energy Facilities in the vicinity of the Richtersveld site

CLIENT: G7 renewable ENERGIES

DATE: SEPT 2011	CHECKED: TS	PROJECT: 0134745
DRAWN: AB	APPROVED: SHC	SCALE: 1 : 380 000

DRAWING: Planned_REF.mxd

REV: 0

ERM
Building 32,
The Woodlands,
Woodlands Drive,
Woodmead, 2148
Johannesburg, South Africa
Tel: +27 (0)11 798 4300
Fax: +27 (0)11 804 2289

Projection: Geographic, Datum: WGS84
Source: NGI, EnPAT, PPF
Inset Map, Esri Data & Maps

SIZE: A3

T:\GIS Project\0117424 G7 Wind Farms\Mapping\MXD\Rigtersveld\Planned_REF.mxd

All reasonable effort has been made to review the current position with respect to other proposed wind farms within a 70 km radius of the Richtersveld Wind Farm. There are currently no existing commercial wind farms within the Northern Cape and none within a 70 km radius of the Richtersveld site. The nearest planned wind energy facilities are more than 300 km to the south near Koekenaap and Lambert's Bay.

Although there are no planned wind farms near the Richtersveld site, they could be developed in the future, therefore, it is 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 mitigation 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 influenced 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.

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

As mentioned above, there are no known planned wind farms within a 70 km radius of the Richtersveld site, therefore, potential for cumulative impacts is low at this stage. In the long–term, the development of a large number of wind energy facilities along the coastline would potentially have a significant cumulative impact, as any ecological processes operating parallel to the coastline could be impacted. Overall the potential of the current site to contribute to cumulative impacts is viewed as being fairly **low** and the major impact of the development will be at a local scale.

The herders who make use of the site may become less reliant on income from stock 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 result in an improvement in the flora and surrounding habitat. However, should farming intensity increase (additional

stock) because of the increase income, this could have a significant negative cumulative impact as additional land take may impact sensitive habitats.

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.

Furthermore, close neighbouring projects may result in the formation of significant barriers to energy-efficient travel between resource areas for regionally important bird populations, and/or significant levels of mortality in these populations in collisions with what may become extensive arrays of 100s of turbines across regular flight paths (Masden *et al*. 2010).

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 eight operational individual wind turbines exist in South Africa, too few to provide any meaningful data on the actual interactions of birds with wind farms. This means that new proposed projects are assessed in the absence of any real local data or experience and more research is required to understand these 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. Despite the fact that there are no proposed other projects in the area, the results of pre-construction monitoring should be applied to project-specific impact mitigation in a way that allows for the potentially considerable

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

cumulative effects on the local/regional avifauna of additional wind energy projects proposed for this area, as development may occur in the future.

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, it is known that two species conduct seasonal migrations Cape Hairy Bat *Myotis tricolour* and Natal Long-fingered Bat *Miniopterus natalensis*. These bats regularly undertake migratory flights between bushveld caves and highveld caves, however, locations of roosting caves and migration routes in South Africa are poorly known and not well documented. Due to uncertainties surrounding the migratory routes of these species it is hard to assess cumulative impacts, however it is likely that if the migratory route of these bats pass through a number of sites, the cumulative impacts to bat populations could be significant. 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.

16.5 CUMULATIVE SOCIO-ECONOMIC IMPACTS

Benefits to the local, regional and national economy through employment and procurement of services could be substantial should all 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. Over time, as businesses develop locally to meet the needs of the renewable energy sector, levels of procurement may increase.

The potential for the proposed Wind Farm and other future projects to result in greater impacts on the local and national economy as a whole is primarily dependent on economies of scale. Initially import content will be high. However, if the sector grows in size it should provide opportunities for growth of the local supply chain and the additional benefits that would flow from this. The introduction of large numbers of wind farms could provide local economic opportunities for component manufacture, and with an appropriate industrial policy it would be possible to leverage South Africa's relatively cheap steel resources. The distance from other international manufacturers will also present a competitive advantage, especially for less-specialised large-scale components such as steel towers.

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. It is likely that as wind farm facilities begin to be established, tourism opportunities linked to the novelty of these facilities may increase. However, once the renewable energy sector is saturated, property prices and tourism opportunities that are dependant on the sense of place value rather than on the agricultural potential may be threatened due to the changes in landscape and sense of place.

16.6 CUMULATIVE VISUAL IMPACTS

The Richtersveld site and surrounding area has a wilderness or rural farmland character, typical of the West Coast landscapes. The sites are remote and sparsely populated, which adds to the attraction of the West Coast as a getaway destination. The sheer scale of the wind farm projects ranging from 30 to few hundred turbines each and 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 tourism and associated activities. A single wind farm located in an area of wilderness or rural farmland character is likely to attract interest, resulting in some positive benefits. However, it is unlikely that several such facilities in relatively close proximity are like 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 wind farms, should they all 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;

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

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[1] 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. At present there are no other wind farms planned within a 50km radius of the Richtersveld Wind Farm.

16.7 CUMULATIVE CULTURAL HERITAGE IMPACTS

Although this proposal is located far enough from other similar proposals, there is a danger that on a national level there is erosion of the aesthetic and wilderness qualities that are very much the character and identity of RSA. However given that the site is isolated from other proposed wind farms, cumulative impacts on heritage sense of place are not anticipated to be significant.

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

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

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 up the West Coast will be built due to capacity constraints on the Eskom grid and the limits placed on renewable energy targets.

17 DECOMMISSIONING

As mentioned in *Chapter 4*, the wind farm would have a minimum life span of up to 25 years. Once the facility has reached the end of its life the turbines may be refurbished and continue operating as a power generating facility, or the facility may be closed and decommissioned. If decommissioned, all the components of the wind farm would be removed and the site would be rehabilitated. The decommissioning and reinstatement of the site would involve many activities that may have environmental and social impacts.

A detailed decommissioning and rehabilitation plan should be developed prior to decommissioning the facility and associated infrastructure in accordance with the relevant environmental authority. This plan should include, but not be limited to, management of socio-economic aspects such as employment creation, removal, re-use and recycling of materials and vegetative rehabilitation to prevent erosion. This impact assessment focussed on potential impacts associated with the construction and operational phase of the proposed Richtersveld Wind Farm. The decommissioning activities would be similar to construction activities and therefore recommendations outlined to manage construction phase impacts should be adhered to during decommissioning. Management actions should focus on the rehabilitation of disturbed areas and the removal of infrastructure.

18 SUMMARY, CONCLUSIONS & RECOMMENDATIONS

18.1 OVERVIEW

The aim of the EIA for the proposed Richtersveld Wind Farm is to provide information to inform decision-making that will contribute to environmentally sound and sustainable development. This report is submitted to the DEA to provide it with information and an independent assessment thus enabling the DEA to make an informed decision regarding whether or not to grant an environmental authorisation for the proposed development in terms of NEMA. If granted, this report will also assist the DEA to define under what conditions the development should go ahead. In considering the development of renewable energy projects, it is inevitable that there will be some negative environmental impacts. However, there is also the need to encourage renewable energy in South Africa in order to move toward more sustainable energy practices and meet targets set by the government of sourcing 10,000 GWh from renewable energy projects by 2013 (1).

The Richtersveld site has been selected from various other sites investigated by G7 as part of the pre-feasibility/ screening study. Through the EIA process which included various stakeholder and specialist input, ERM has identified and assessed a number of issues relating to G7's proposed Wind Farm at Richtersveld. This chapter provides an overview of the EIA findings and makes recommendations regarding key mitigation measures for the preferred and final layout (Alternative 2) which supersedes the original layout Alternative 1.

The final layout (Alternative 2) has been designed based on the sensitivity constraints of the site as established during the EIA process and available wind data from G7. *Figure 18.1* shows the site layouts Alternative 1 and Alternative 2 (final layout), and illustrate how the site layout has been changed based on specialist feedback and input received during the focus group meetings. The final layout of the turbines has been based on the best available information but may require some minor alterations to the layout based on geo-technical studies, turbine manufacturer and model selection, etc. Any revisions of the design will however be within the allowable zones prescribed by this EIR. The final layout will be subject to field checks by specialists where required, see recommendations below. Any amendments to the final layout will be submitted to DEA before construction with an indication of the extent of change and associated changes in significance ratings of impacts where applicable.

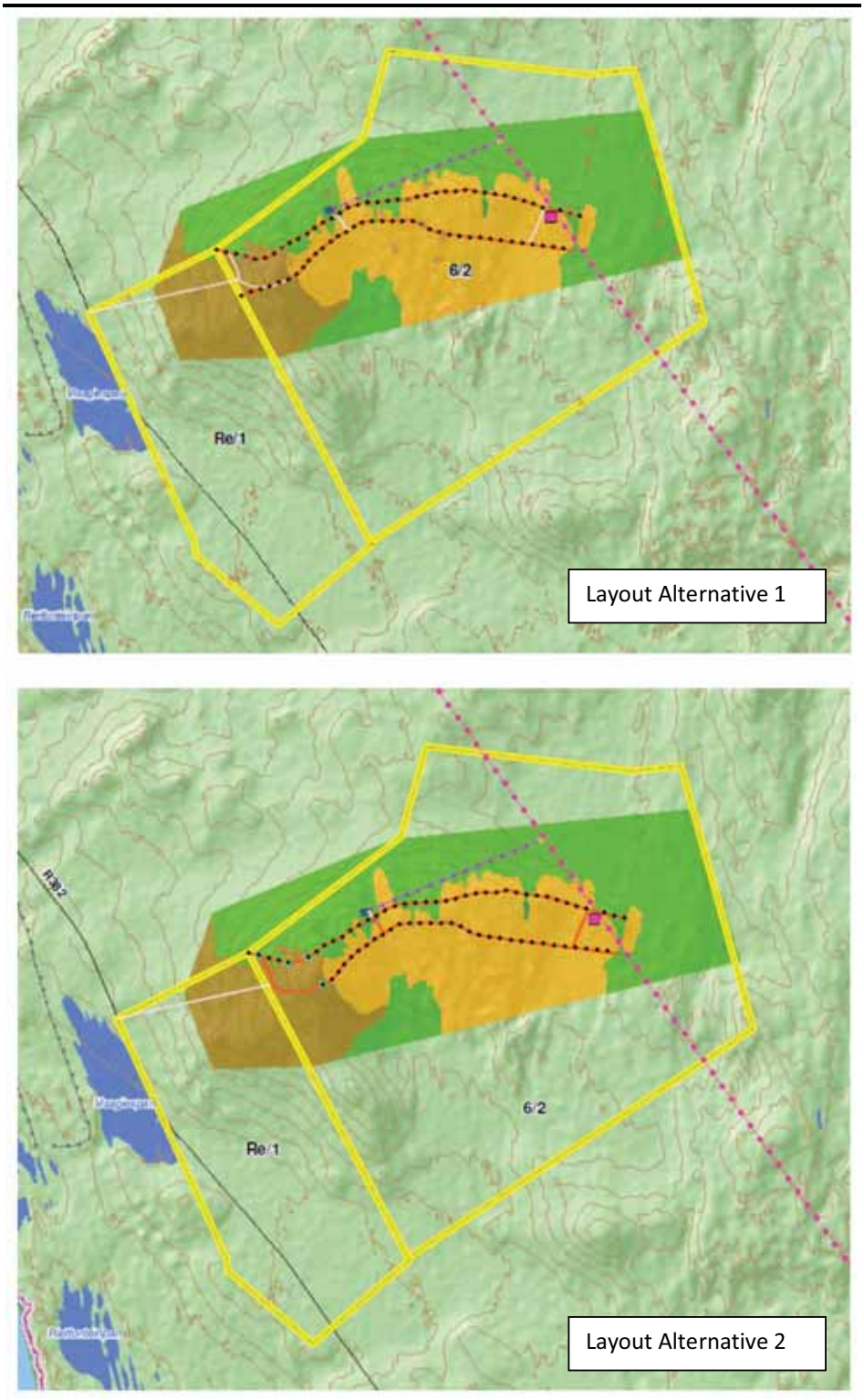
This EIA report provides a description of the EIA process followed to date including the public participation process that has been undertaken for the

(1) National Energy Regulator of South Africa **South Africa Renewable Energy Feed-In Tariff** (2009) NERSA Publications.

submission of this Final Impact Assessment Report to the Department of Environmental Affairs for decision-making.

The potential impacts associated with the development are summarised below and should be considered both in the context of the project rationale and the discussion of cumulative impacts in the previous chapter.

Figure 18.1 Changes made to the site layout from Alternative 1 to Alternative 2



18.1.1 Comparative assessment of Alternative 1 and 2

Below is a comparative assessment table for the layouts identified as feasible alternatives, followed by a short discussion.

Table 18.1 Comparative assessment of layout alternative 1 and 2

Aspect	Site Layout Alternative 1	Site Layout Alternative 2
Number of turbines	75 turbines	69 turbines
Electricity generation capacity	Up to 225 MW output for turbines up to 3 MW	Up to 207 MW output with a resultant reduction in output of up to 18 MW compared to Site Layout Alternative 1
Flora and Fauna	Turbines are located in an area identified as Highly Sensitive by the appointed Ecologist. This affects flora and faunal habitats.	Six turbines have been removed from the Highly Sensitive Area and four turbines will be micro-sited to avoid the Highly Sensitive Area.
Birds	Turbines located in close proximity to nests and foraging areas.	Pre-construction monitoring will inform no-go areas.
Bats	No areas have been buffered for bat sensitivity.	A buffer zone around the granite outcrops, (potentially sensitive habitat) will assist in avoiding impacts on bats.
Noise Impact	Noise impacts on sections of the boundary were identified with Site Layout Alternative 1.	Mitigation measures such as to obtain a letter of consent to accept such noise impact from the owner of the neighbouring farm (also CPA) or possible exemption according to Noise Control Regulations are currently underway.
Cultural Heritage	No buffers have been included around significant finds or sites.	Buffer around archaeological and palaeontological sites.

In the above table, each of the attributes for the site alternatives has been given a "green" or "red" colour. Green indicates that the attribute is favourable in relation to that particular alternative in relation to the other and red indicates that it is not favourable.

The table clearly shows that avoidance of areas based on specialist input has resulted in more favourable attributes relating to Site Layout Alternative 2 when compared to Site Alternative 1. Although **Site Layout Alternative 2** has resulted in a decreased electricity generation capacity for the project, the positive trade-off is the reduction in the environmental impacts in the table above, through avoidance as the first step in mitigating potential impacts and this is therefore the **preferred layout alternative**.

This draft EIA report provides a description of the EIA process followed to date including the public participation process that has been undertaken and which will continue through to the submission of the Final Impact Assessment Report to the Department of Environmental Affairs for decision-making.

The potential impacts associated with the development are summarised below and should be considered both in the context of the project rationale and the discussion of cumulative impacts in the previous chapter.

18.2 SUMMARY OF IMPACTS IDENTIFIED AND ASSESSED

18.2.1 Construction Phase Impacts

It is estimated that approximately one percent of the site will be taken up by the various components of the wind farm including hard standing areas for laying down equipment for assembly and standing area for cranes required during construction.

The loss or damage/ disturbance of vegetation and impacts to reptiles and mammals from habitat loss or disturbance or damage are predicted to be of minor, to minor - moderate negative residual significance during the 24 month construction period. There is a number of flora and fauna species of conservational importance, which may be affected by construction activities. The residual impacts associated with fauna and flora is based on G7's commitment to the implementation of mitigation measures and rehabilitation outlined in the EMP.

The main sources of noise expected during construction would be heavy earthmoving vehicles, delivery vehicles and construction equipment for concrete mixing, sheet piling and steel works. Noise levels during construction will rise above ambient levels at this rural setting and therefore impacts are predicted to be of minor - moderate significance.

Large equipment or infrastructure such as turbines, when being erected, as well as cranes will create visual intrusions or impacts on the site during construction. Impacts are considered to be of moderate – major significance during the 24 month construction period.

Impacts of minor - moderate positive significance would be associated with finds of paleontological interest on the Richtersveld site such as fossils or bones as such finds, would add to the existing scientific data of the region.

The benefits to the local economy associated with the construction phase of the project warrants a moderate positive significance rating associated with the benefits from employment as well as local procurement.

A summary of the bio-physical and socio-economic impacts associated with the construction phase of the Richtersveld Wind Farm including their pre-mitigation significance, key mitigation measure and residual impacts, are given in *Table 18.2* below. From the table one can see that bio-physical and socio-economic impacts associated with construction are largely of moderate or minor significance before mitigation measures have been implemented. The potential impact on buried graves has been allocated a major significance prior to mitigation. Following the implementation of the mitigation measures recommended in this EIR and EMP (*Annex L*) the significance rating of all of the negative construction impacts can be reduced to minor-moderate or

minor. From the summary table below, one can see that, following the implementation of mitigation measures and monitoring, no major negative impacts are anticipated during the construction phase of the Richtersveld Wind Farm. The positive impact of economic benefits remains moderate positive.

Table 18.2 Summary of pre-mitigation and residual impacts of the bio-physical and socio-economic environment during construction

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
Flora and Fauna	7.1	Loss of Vegetation	**MODERATE (-VE)**	• Area mapped as Very High Sensitivity should not be developed. Requires removal of 6 turbines as well as micro-siting of 4 turbines that are just within this area. • Where feasible, re-routing or relocating some of the other infrastructure such as the underground cabling to avoid excessive disturbance in the Very High Sensitivity area should be considered. • Lay down area requirements should be minimised and sites selected with assistance of a botanist to ensure siting in areas with lowest conservation value and/or where listed species are absent. • Final layout should be assessed in the field prior to commencement of construction activities so that exact placement of turbines can be adjusted to avoid potentially sensitive areas. • Location of borrow pits and other infrastructure or major activity not specifically dealt with in EIA phase should be assessed in the field prior to construction to ensure that suitable sites are identified. • Where construction does not require clearing of vegetation, construction should occur without clearing the vegetation as far as possible. • No temporary lay down areas should be located within the dunes habitat, but rather located on the plains which are likely to recover more quickly and with less long-term impact from disturbance. • Where construction vehicles must traverse the site, they must remain on demarcated roads. If vehicles must leave the road for construction purposes, they should utilize a single track and should not take multiple paths.	**MINOR (-VE)**
	7.2	Loss of Threatened Species	**MODERATE (-VE)**	• The same mitigation measure listed above apply to this impact. • As many of the listed species are geophytes and succulents, the potential for successful translocation is high. Therefore, it is recommended that before construction commences, individuals of listed species within the development footprint should be marked and translocated to similar habitat outside the development footprint under the supervision of an ecologist or someone with experience in plant translocation. Permits from the relevant provincial authorities will be required to relocate listed plant species.	**MINOR (-VE)**
	7.2	Faunal impacts (Disturbance)	**MINOR - MODERATE (-VE)**	• Measures of habitat loss above should be implemented to minimise impacts to fauna.	**MINOR (-VE)**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
Birds	8.1	Habitat loss and Disturbance	**MODERATE (-VE)**	• On-site demarcation of 'no-go' areas identified during pre-construction monitoring to minimise disturbance impacts associated with the construction of the facility. These will apply in particularly to areas preferred by Barlow's Lark. • Minimizing the disturbance impacts associated with the operation of the facility, by scheduling maintenance activities to avoid disturbance in sensitive areas (identified through operational monitoring). These sensitive areas will apply in particularly to habitats favoured by Barlow's Lark.	**MINOR - MODERATE (-VE)**
Bats	9.1	Habitat loss, destruction, disturbance and displacement	**MODERATE (-VE)**	• Construction and operational phase impacts can be mitigated by keeping construction and operational activities out of areas of High Bat Conservation Importance. • Avoid blasting near the rock outcrop areas, as identified in this EIR (*Figure 5.14*) • Caution should be taken to ensure construction footprints are kept to an absolute minimum, including storage of materials, stockpiling etc. • Any roosting caves identified by a bat specialist during pre-construction bat monitoring, should have a buffer, with no development occurring within this buffer zone. The size of the buffer should be determined by the bat specialist, pending the outcome of further investigation. • Implementing pre- construction monitoring (see *Chapter 9)* to provide additional detailed baseline data to help define clearer mitigation measures, such as construction times.	**MINOR (-VE)**
Soils, Surface and Groundwater	10.1	Loss of topsoil, compaction and erosion	**MODERATE (-VE)**	• Restrict removal of vegetation and soil cover to those areas necessary for the development. • Implement soil conservation measures such as stockpiling top soil for remediation of disturbed areas. • Proper drainage controls such as culverts, cut-off trenches to be used to ensure proper management of surface water runoff to prevent erosion. • Stockpiles should be vegetated or appropriately covered to reduce soil loss as a result of wind or water to prevent erosion. • Disturbed areas to be rehabilitated as soon as possible to prevent erosion and the use of shade cloth to minimise effects of wind erosion and facilitate vegetation regrowth. • Work areas to be clearly defined and demarcated, where necessary, to avoid unnecessary disturbance or areas outside the development footprint. • Construction vehicles to remain on designated and prepared roads.	**MINOR (-VE)**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
	10.2	Impact on surface and groundwater	**MINOR (-VE)**	• Soil stockpiles to be protected from wind erosion through placement, vegetation or appropriate covering; • Proper drainage controls such as culverts, cut-off trenches used to ensure proper management of surface water runoff to prevent erosion; • Cleared or disturbed areas to be rehabilitated as soon as possible with the use of shade cloth protection to prevent erosion; • Fuel, oil and used oil storage areas to have appropriate secondary containment (i.e. bunds); • Spill containment and clean up kits to be available onsite and clean-up from any spill to be appropriately contained and disposed of; and • Construction vehicles and equipment to be serviced regularly and provided with drip trays, if required.	**MINOR (-VE)**
Noise Impact	11.1	Construction noise	**MODERATE (-VE)**	• Mechanical equipment with lower sound power levels to be selected to ensure that permissible occupation noise-rating limit of 85 dBA is not exceeded. Construction workers and personnel will wear hearing protection when required. • Vehicles and machines to be properly serviced and well maintained. • G7 to require drivers to adhere to the speed limit of 40km/hr on gravel roads. • A grievance procedure to be established whereby noise complaints by neighbours are recorded and responded to.	**MINOR - MODERATE (-VE)**
Visual	12.2	Visual impact on fixed and temporary receptors	**MODERATE - MAJOR (-VE)**	• The design of the buildings should be compatible in scale and form with buildings of the surrounding area and yards and storage areas to be enclosed by masonry walls. • Cables should be located underground where possible to minimise visual clutter. • The substation transformers, which have a high degree of visual intrusion, to be screened by the various buildings. • The extent of the construction camp and stores should be limited in area to only that which is essential. • Disturbed areas rather than pristine or intact landscape areas should preferably be used for the construction camp.	**MODERATE - MAJOR (-VE)**
Cultural Heritage	13.1	Impact on the palaeontological heritage	**MINOR (-VE)**	• No–go areas identified in this report to be clearly demarcated so that they are excluded from construction activities. • Trenches and excavations to be checked by a palaeontologist. The collection of new scientific information is a positive impact.	**MINOR - MODERATE (+VE)**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
	13.1	Impact on pre-colonial archaeology and built environment	**MODERATE (-VE)**	• No –go areas identified in this report to be clearly demarcated so that they are excluded from construction activities. • Mitigation of palaeontological heritage can be achieved by ensuring that trenches and excavations are checked by a palaeontologist. The collection of new scientific information is a positive impact.	**MINOR (+VE)**
	13.1	Impact on Graves Construction	**MAJOR (-VE)**	• Should any human burials, archaeological or palaeontological materials (fossils; bones; artefacts; cultural material such as historic glass, ceramics, etc; sub-surface structures, graves etc) be uncovered or exposed they must immediately be reported to the South African Heritage Resources Agency (SAHRA).	**MINOR (+VE)**
Socio-economic	14.1	Benefits to the local economy	**MODERATE (+VE)**	• Enhance local community development. • Optimise opportunities for employment/procurement of local people/suppliers	**MODERATE (+VE)**
	14.2	Increased social ills	**MINOR (-VE)**	• Develop code of conduct for employees. • Establishment of grievance procedure. • HIV/Aids policy.	**MINOR (-VE)**
	14.3	Disruption to agricultural activities	**MINOR (-VE)**	• Construction schedule to be agreed with the CPA and herders who use the land on a seasonal basis. • All workers will agree to the Code of Conduct. • Establishment of grievance procedure.	**NEGLIGIBLE**
	14.4	Loss of agricultural land	**MINOR (-VE)**	• Design of infrastructure layout limiting footprint of the facility and associated infrastructure. • Rehabilitate damage to natural vegetation. • Implement a 'Code of Conduct' governing workers.	**NEGLIGIBLE**
	14.5	Tourism	**NEGLIGIBLE**	• Mitigate noise and visual impacts as far as possible. • Work with local municipality and local tourism organisations to raise awareness.	**NEGLIGIBLE**
	14.6	Sense of place	**MINOR (-VE)**	• Mitigate noise and visual impacts as far as possible. • The construction activities will be undertaken in accordance with a schedule that will be approved by the landowners.	**NEGLIGIBLE**
Other Impacts	15.1	Dust	**MINOR (-VE)**	• Vehicles must not exceed a speed of 40 km/hr • Stockpiles of dusty materials must be enclosed or covered by suitable shade cloth or netting • Use of Grievance Procedure by neighbouring landowners	**MINOR (-VE)**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
	15.1	Emissions	**NEGLIGIBLE**	• Vehicles are to be kept in good working order and serviced regularly to minimise emissions	**NEGLIGIBLE**
	15.2	Traffic	**MODERATE (-VE)**	• If abnormal loads required for maintenance, appropriate arrangements must be made to obtain necessary transportation permits and the route agreed with the relevant authorities to minimise the impact on other road users. • All directly affected and neighbouring farmers and local residents must be able to lodge grievances with G7 using the Grievance Procedure.	**MINOR (-VE)**
		Waste and Effluent	**MINOR (-VE)**	• All waste to be separated into skips for recycling, reuse and disposal. • Vegetative material to be kept on site and mulched after construction to be spread over the disturbed areas to enhance rehabilitation of the natural vegetation. • Effluent from temporary staff facilities to be collected in storage tanks, emptied by sanitary contractor. • Effluent from concrete washings from the on-site batching plant to be contained within a bunded area. • All solid and liquid waste materials, including any contaminated soils, to be stored in a bunded area and disposed of by a licensed contractor. • Effluent and stormwater run-off to be discharged away from any water courses; • Steel off-cuts must be re-used or recycled, as far as possible. • Materials that cannot be re-used or recycled must be placed in a skip and removed from site to a licensed municipal disposal site.	**MINOR (-VE)**
	15.4	Health and safety	**MINOR (-VE)**	• A health and safety plan to be developed prior to the commencement of construction. 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 to be clearly demarcated (i.e. unattended foundation excavations). • Appropriate Personal Protection Equipment (PPE) to be worn by all construction personnel.	**NEGLIGIBLE**

18.2.2 Operational Phase Impacts

Impacts to birds and bats are expected to be of moderate significance during the operational phase of the Richtersveld Wind Farm from collisions with turbines. Bats are likely to suffer from barotrauma if they come into close proximity to the turbines and impacts similarly will be of moderate significance. Birds may exhibit avoidance behaviour from the physical presence of the moving turbine blades and associated noise and due to the lack of information around bats in the area, impacts will be of moderate significance. It is important to note that pre- and post-construction monitoring is required to mitigate impacts on birds and bats. Residual significance ratings given for birds and bats in this report are premised on the fact that pre-construction monitoring may assist in refining the final design and mitigation measures of the proposed wind farm. Post-construction mitigation will contribute to improving knowledge of the movement of birds and bats in the area and to assess actual impacts associated with the proposed development. Monitoring will begin before commencement of construction and continue into the operational phase of the facility.

The turbines will remain a prominent feature upon the ridgeline on the Richtersveld site and be visible to landowners, local residents, as well as passers-by and tourists visiting the West Coast Region. As a result, impacts of moderate - major significance are inevitable to temporary receptors and fixed receptors taking into consideration the proposed mitigation. Due to the proposed design of the substation complex, impacts of minor significance are anticipated. The Richtersveld facility will not be highly visible at night as the lights on the turbines will be fitted with reflectors to avoid it from being seen from below and impact significance is predicted to be minor - moderate.

Negligible impacts are predicted for the tourism industry as there are no tourism facilities on or within close proximity to the proposed project site. Moderate positive significance ratings have been assigned to benefits to the local economy associated with the operational phase of the Wind Farm.

The impacts associated with the Richtersveld Wind Farm mentioned above, as well as those with low or negligible significance are summarised in *Table 18.3*, below. From the table one can see that bio-physical and socio-economic impacts associated with the operational phase are largely of moderate or minor-moderate significance, with major impacts associated with the impact on bats before mitigation measures have been implemented. The potential impacts on birds and the potential noise impact has been given a moderate – major impact prior to mitigation. Following the implementation of the mitigation measures recommended in this EIR and EMP (*Annex L*) the significance rating of most of the negative operational impacts can be reduced to minor-moderate or minor. The noise impact will remain moderate-major, however, G7 are committed to compliance with the Noise Control Regulations and will ensure the appropriate exemptions are obtained during the operation of the Richtersveld Wind Farm. From the summary table below, one can see

that, following the implementation of mitigation measures and monitoring, no major negative impacts are anticipated during the operational phase of the Richtersveld Wind Farm. The positive impact of economic benefits remains moderate positive.

Table 18.3 Summary of residual bio-physical and social residual impacts during the operational phase of the project

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
Fauna and Flora	7.2	Alien Plant Invasion	**MINOR - MODERATE (-VE)**	• Only disturb the minimum area required for the roads and turbine hard standings. Since only the bare soils would be vulnerable to erosion, this should be minimized wherever possible. • Disturbed areas which will not be used, should be rehabilitated as soon after construction as possible • Plants from cleared areas should be relocated to sites that require rehabilitation or re-vegetation wherever possible. • Regular monitoring of the site (minimum of twice annually) for all erosion-related problems is recommended. • All bare areas should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential. • Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring.	**MINOR (-VE)**
	7.2	Hunting and Collecting of Fauna & Flora	**MODERATE**		**MINOR (-VE)**
	7.2	Loss of landscape connectivity for fauna	**MINOR – MODERATE (-VE)**		**MINOR (-VE)**
Birds	8.1	Displacement	**MODERATE - MAJOR (-VE)**	• Minimize the disturbance impacts associated with the operation of the facility, by scheduling maintenance activities to avoid disturbance in sensitive areas (identified during monitoring).	**MODERATE (-VE)**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
	8.2	Mortality (Collisions)	**MODERATE (-VE)**	• Ensuring that lighting on the turbines is kept to a minimum (but in line with aviation regulations), and is coloured (red or green) and intermittent, rather than permanent and white, to reduce confusion effects for nocturnal migrants. • Minimising the length of any new power lines installed, ensuring that all new lines are marked with bird flight diverters (Jenkins et al. 2010) along their entire length, and that all new power line infrastructure is adequately insulated and bird friendly in configuration (Lehman et al. 2007). • Carefully monitoring the local avifauna pre- and post-construction (see Section 8.3), and implementing appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in this report, or when collision or electrocution mortalities are recorded for any of the priority species listed in this report. •	**MINOR – MODERATE (-VE)**
Bats	9.1	Habitat loss – Destruction, disturbance and displacement	**MINOR (-VE)**	• Adhere to the recommendations informed by long-term bat monitoring.	**MINOR (-VE)**
	9.2	Collision of bats with turbines	**MAJOR (-VE)**	• Implementing pre- and post-construction monitoring (see *Section* ***Error! Reference source not found.***) to provide additional detailed baseline data to help define clearer mitigation measures, and to monitor the impacts on bats once the facility is operational.	**MODERATE (-VE)**
	9.3	Barotrauma	**MAJOR (-VE)**	• Implementing pre- and post-construction monitoring (see *Section* ***Error! Reference source not found.***) to provide additional detailed baseline data to help define clearer mitigation measures, and to monitor the impacts on bats once the facility is operational.	**MODERATE (-VE)**
Soils, surface and groundwater	10.1	Loss of topsoil, compaction and erosion	**MINOR (-VE)**	• Laydown or infrastructure assembly areas which will not be required during the operational phase of the facility to be re-vegetated with indigenous vegetation to prevent erosion. • Bi-annual monitoring of erosion in the vicinity of the turbines, roads and other hard-standing surfaces will be conducted before and after the rainy season to ensure erosion sites can be identified early and remedied.	**MINOR (-VE)**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
	10.2	Impact on surface and groundwater	**MINOR (-VE)**	• Fuel, oil and used oil storage areas to have appropriate secondary containment (i.e. bunds); and • Areas disturbed during construction to be re-vegetated with indigenous vegetation to prevent erosion.	**MINOR (-VE)**
Noise Impact	11.2	Wind turbine noise during operation (at the boundary)	**MAJOR - MODERATE (-VE)**	Ensure compliance with Noise Control Regulations by: • Applying for and obtaining, an exemption from the Richtersveld Local Municipality where prohibitions determined in the applicable NCR would be contravened by the establishment of the proposed wind farm. • Incorporating land adjacent to the north western boundary into the proposed site or negotiating an agreement with the adjacent land owner that the noise impact will be acceptable.	**MAJOR - MODERATE (-VE)**
Visual Impact	12.2	Visual impact on fixed receptors (wind turbines)	**MODERATE - MAJOR (-VE)**	• Signage related to the Wind Farm must be discrete and confined to entrance gates. No other corporate or advertising signage, particularly billboards, to be permitted. • The footprint of the operations and maintenance facilities, as well as parking and vehicular circulation, should be clearly defined, and not be allowed to spill over into other areas of the site. • The operations and maintenance areas should be screened by buildings, walls, hedges and/or tree planting, and should be kept in a tidy state to minimise further visual impacts. • The navigation lights on the wind turbines should be fitted with reflectors so that the lights are not directly visible from below.	**MODERATE - MAJOR (-VE)**
	12.2	Visual impact on fixed receptors (substation complex)	**MINOR - MODERATE (-VE)**	• As Above	**MINOR (-VE)**
	12.2	Visual impact on fixed receptors (at night)	**MODERATE (-VE)**	• As Above	**MINOR - MODERATE (-VE)**
	12.3	Visual impact on temporary receptors (day time)	**MODERATE - MAJOR(-VE)**	• As Above	**MODERATE - MAJOR(-VE)**
	12.3	Visual impact on temporary receptors (at night)	**MODERATE (-VE)**	• As Above	**MINOR - MODERATE (-VE)**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
Cultural Heritage	13.2	Cultural heritage visual or sense of place	**MODERATE (-VE)**	• No effective mitigation. • Effective downlights on turbines may reduce night time impact.	**MODERATE (-VE)**
Socio-economic	14.1	Benefits to the local economy	**MODERATE (+VE)**	• Develop code of conduct for employees. • Establishment of grievance procedure. • HIV/Aids policy.	**MODERATE (+VE)**
	14.2	Social Ills	**NEGLIGIBLE**	• Develop code of conduct for employees. • Establishment of grievance procedure. • HIV/Aids policy.	**NEGLIGIBLE**
	14.3	Disruption to agricultural activities	**NEGLIGIBLE**	• All maintenance workers will agree to the Code of Conduct. • Establishment of grievance procedure.	**NEGLIGIBLE**
		Loss of agricultural land	**MINOR (-VE)**	• Design of infrastructure layout limiting footprint of the facility and associated infrastructure. • Rehabilitate damage to natural vegetation. • Implement a 'Code of Conduct' governing workers.	**NEGLIGIBLE**
	14.4	Tourism activities	**NEGLIGIBLE**	• Mitigate noise and visual impacts as far as possible. • Work with local municipality and local tourism organisations to raise awareness. • Establish information kiosk/notice board to raise awareness and inform public.	**NEGLIGIBLE**
		Sense of place	**MINOR (-VE)**	• Mitigate noise and visual impacts as far as possible. • The construction activities to be undertaken in accordance with a schedule that will be approved by the landowners, subject to lease agreement.	**NEGLIGIBLE**
Other Impact	15.1	Dust and emissions	**NEGLIGIBLE**	• Vehicles travelling on unpaved or gravel roads must not exceed a speed of 40 km/hr	**NEGLIGIBLE**
	15.2	Traffic	**MINOR (-VE)**	• If abnormal loads are required for maintenance, the appropriate arrangements must be made to obtain the necessary transportation permits and the route agreed with the relevant authorities to minimise the impact on other road users. • All directly affected and neighbouring farmers and local residents to be able to lodge grievances with G7 using the Grievance Procedure.	**NEGLIGIBLE**

Environmental Aspect	Section	Impact	Pre-mitigation Significance	Key Mitigation Measures	Residual Impact Significance
	15.3	Waste and effluent	**MINOR (-VE)**	• Used oil stored on site to be stored in an impervious container, within a bunded area • General waste to be removed from site by a licensed contractor	**NEGLIGIBLE**
	15.4	Health and safety	**MINOR (-VE)**	• Regular maintenance of turbines and all other infrastructure to be undertaken to ensure optimal functioning and reducing the chance of gearbox failure • Regular inspections of the turbine foundations, towers, blades, spinners and nacelle to be undertaken in order to check for early signs structural fatigue	**NEGLIGIBLE**
	15.5	Shadow flicker	**MODERATE (-VE)**	• Should shadow flicker be identified as a problem at any of the stock-posts on site, G7 will undertake the necessary measure to mitigate this impact.	**MINOR (-VE)**

18.3 RECOMMENDATIONS

The implementation of the mitigation measures detailed in Chapters 7 to 15 and listed in the Environmental Management Programme (EMP) (*Annex L*), including additional pre-construction monitoring will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the Richtersveld Wind Farm are enhanced and mitigated to a level which is deemed adequate for the development to proceed. Not all impacts can be fully mitigated, for example, visual impacts relating to wind farms are inevitable. ERM however feels confident that every effort has been made by G7 to accommodate the mitigation measures recommended during the EIA process to the extent that is practically possible, without compromising the economic viability of the proposed wind farm. Uncertainties around cumulative impacts associated with similar developments in the greater vicinity of Richtersveld and the growth of the renewable energy sector requires strategic planning and cooperation on a provincial and national level. Input from developers, organisations such as the Endangered Wildlife Trust, Bird Life South Africa and other stakeholders must inform the strategic planning. This however falls beyond the scope of this study.

In summary, based on the findings of this assessment, ERM finds no reason why the Wind Farm proposed at Richtersveld should not be authorised, contingent that the mitigations and monitoring for potential environmental and social impacts as outlined in the EIR and EMP are implemented.

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The CPA lawyer, Mr Henning Pietersen;
The current CPA Chairman, Mr Willem Diergaardt;
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