ENVIRONMENTAL IMPACT ASSESSMENT PROCESS AMENDED FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PROPOSED HIDDEN VALLEY WIND ENERGY FACILITY (COMPRISING THREE DEVELOPMENT PHASES) ON A SITE SOUTH OF SUTHERLAND, NORTHERN CAPE PROVINCE

(DEA Ref. Nos: 12/12/20/2370/1-3)

AMENDED FINAL FOR PUBLIC REVIEW
APRIL 2014

Prepared for:

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PROJECT DETAILS

DEA Reference Numbers	:	» 12/12/20/2370/1 (Phase 1: Karusa Wind Farm) » 12/12/20/2370/2 (Phase 2: Soetwater Wind Farm) » 12/12/20/2370/3 (Phase 3: Great Karoo Wind Farm)
Title	:	Environmental Impact Assessment Process Amended Final Environmental Impact Assessment Report: Proposed Hidden Valley Wind Energy Facility (Comprising Three Development Phases) on a site south of Sutherland, Northern Cape Province
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Client	:	ACED Renewables Hidden Valley (Pty) Ltd – Phase 1 Soetwater Wind Farm (Pty) Ltd – Phase 2 Great Karoo Wind Farm (Pty) Ltd – Phase 3
Report Status	:	Amended Final Environmental Impact Assessment Report for public review
Review Period	:	22 April 2014 – 16 May 2014

When used as a reference this report should be cited as: Savannah Environmental (2014) Amended Final EIA Report: Proposed Hidden Valley Wind Energy Facility (Comprising Three Development Phases) on a site south of Sutherland, Northern Cape Province.

PURPOSE OF THE PUBLIC REVIEW PERIOD FOR THE AMENDED FINAL EIA REPORT

African Clean Energy Developments (Pty) Ltd (ACED) under three special purpose vehicle's (SPV's) is proposing to establish three commercial wind energy facilities and associated infrastructure on a site located within the Karoo Hoogland Local Municipality (approximately 30 km south of Sutherland in the Northern Cape Province). A combined site has been identified for consideration within an Environmental Impact Assessment (EIA) and this amended final report is submitted after taking account of feedback received from the Department of Environmental Affairs on the initial report submitted in final form in 2012. Up to 207[1] wind turbines were proposed to be constructed across three separate phases over an area of approximately 340 km^2 in extent. This has subsequently been reduced to 170 wind turbines in response to EIA specialist recommendations and is described in the conclusions chapters for each phase and this revised layout is supported by letters provided by the EIA specialists. Associated infrastructure includes substations, workshops, control and administration and security facilities, access roads and power lines associated with each phase of the project. Three project development phases are proposed, namely:

» Phase 1: Proposed Karusa Wind Farm
» Phase 2: Proposed Soetwater Wind Farm
» Phase 3: Proposed Great Karoo Wind Farm

The EIA process for the Hidden Valley Wind Energy Facility commenced in August 2011. A draft Environmental Impact Assessment Report was released for public review in March 2012. Thereafter, the final EIA report was submitted to DEA in April 2012. In May 2013 DEA requested the following:

» The applicant to appoint specialists to conduct pre-construction bird and bat monitoring.
» The EAP to amend the Final EIA report by including the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes.

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[1] The following minor amendments to the project information have been made:

» One turbine was erroneously included in Phase 2 which is now included into Phase 1. Therefore, Phase 1 originally had 75 turbines, and now has 74 turbines. Phase 2 originally had 55 turbines, and now has 56 turbines.

» The numbering of turbines as indicated in the maps within the main EIA report (only) has changed. However, the locations of the turbines have not changed and the layout remains the same) as presented in the draft and final EIA published in 2012(apart from re-numbering of the turbines). The number of wind turbines for all three phases remains as 207 in total.

» Allow registered I&APS an opportunity to comment on the amended Final EIA Report.
» Resubmit the amended Final EIA Report together with any comments received from registered I&APs to DEA for final decision-making.

Therefore, the purpose of this amended Final EIA Report for the Hidden Valley Wind Energy Facility is to include the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes. **Changes between the Final EIA report of April 2012 and this amended EIA Report of April 2014 has been shown in underlined text.** In addition the following minor amendments to the project information have been made:

» One turbine was erroneously included in Phase 2 which is now included into Phase 1. Therefore, Phase 1 originally had 75 turbines, and now has 74 turbines. Phase 2 originally had 55 turbines, and now has 56 turbines.
» The numbering of turbines as indicated in the maps within the main EIA report (only) has changed. However, the locations of the turbines have not changed and the layout remains the same) as presented in the draft and final EIA published in 2012(apart from re-numbering of the turbines). The number of wind turbines for all three phases remains as 207 in total.

The amended Final EIA report has been now been complied and is available for public review by all stakeholders and registered I&APs prior to the submission to the National Department of Environmental Affairs.

The purpose of the bird and bat pre-construction monitoring programmes was to provide baseline data to support the findings of the avifauna and bat impact assessments in line with the Best Practice Guidelines for bird and bat monitoring, and to ensure that appropriate mitigation measures are recommended. This approach also aimed to ensure that the DEA has sufficient information on which to make a decision. The results of the bird and bat pre-construction monitoring programmes for the Hidden Valley Wind Energy Facility have been considered in this amended Final EIA Report.

This amended Final EIA Report for the Hidden Valley Wind Energy Facility has been released for a 21- day public review period, prior to submission of the final report to DEA. The public review period is from 17 April 2014 – 16 May 2014. Registered I&APs have been informed via letter that this amended Final EIA Report is available for comment, and that copies of the report can be requested from Savannah Environmental or downloaded from the website: www.savannahSA.com. The copy of the amended Final EIA report has also been placed at the Sutherland Public Library in Sutherland and at the Lord Milner Hotel in Matjiesfontein.

Please submit your comments to
Gabriele Wood of Savannah Environmental (Pty) Ltd P.O. Box 148, Sunninghill, 2157 Tel: 011 656 3237 Fax: 086 684 0547 Email: gabriele@savannahsa.com
The due date for comments on the amended Final EIA Report is 16 May 2014

Any final comments received will be incorporated into the amended Final EIA Report for submission to DEA.

SUMMARY: ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Project Information

African Clean Energy Developments (Pty) Ltd (ACED) under three special purpose vehicle's (SPV's) is proposing to establish three commercial wind energy facilities and associated infrastructure on a site located within the Karoo Hoogland Local Municipality (approximately 30 km south of Sutherland in the Northern Cape Province). A combined site has been identified for consideration within an Environmental Impact Assessment (EIA) and this amended final report is submitted after taking account of feedback received from the Department of Environmental Affairs on the initial report submitted in final form in 2012.

ACED is proposing to establish three wind energy facilities (with associated infrastructure) on a site located within the Karoo Hoogland Local Municipality. The combined site identified for consideration within an Environmental Impact Assessment (EIA) is within the Northern Cape Province, and lies approximately 30 km south of Sutherland (Northern Cape) and 30 km north of Matjiesfontein (Western Cape). Up to **207 wind turbines** (74 turbines for Phase 1, 56 turbines for Phase 2 and 77 turbines for Phase 3) were proposed to be constructed over the extent of a larger area of approximately 340 km^2 in extent but as mentioned above this has been reduced to 170 wind turbines in response to assessments and specialist recommendations. The generation capacity of the facility will depend on the turbine choice selected by ACED but will be limited to a maximum of 140MW (measured at the point of connection to the Eskom grid) per phase. The larger project development area is proposed to be developed in a three-phased approach. As each phase of the project will be constructed and operated by a separate Special Purpose Vehicle, separate Environmental Authorisations will be required to be obtained

Three project development phases are proposed, namely:

» Phase 1: Proposed Karusa Wind Farm
» Phase 2: Proposed Soetwater Wind Farm
» Phase 3: Proposed Great Karoo Wind Farm

The nature and extent of the full extent of the wind energy facility (i.e. the three development phases), as well as potential environmental impacts associated with the construction and operation of a facility of this nature are assessed in this Environmental Impact Assessment (EIA) Report.

EIA Process

The proposed project is subject to the requirements of the Environmental Impact Assessment Regulations (EIA Regulations) of June 2010 published in terms of Section 24(5) of the National Environmental Management Act (NEMA, No 107 of 1998).

An Environmental Impact Assessment (EIA) process refers to that process (dictated by the EIA Regulations) which involves the identification of and assessment of direct, indirect and cumulative environmental impacts associated with a proposed project. The EIA process comprises two phases: **Scoping Phase** and **EIA Phase**. The EIA process culminates in the submission of a Final EIA Report (including an environmental management programme (EMPr)) to the competent authority for decision-making.

The conclusions and recommendations of this EIA are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

Conclusions of the EIA: Phase 1: Karusa Wind Farm

The Karusa Wind Farm is proposed on the following farm portions (which collectively occupies land of 136.2 km^2 in extent):

» Farm De Hoop 202
» Farm Standvastigheid 210
» Portion 1, 2, 3 and the remainder of Farm Rheebokke Fontein 209

The project will include up to **57 wind turbines**[2], appropriately spaced to make use of the wind resource on the site. The generating capacity of the facility will depend on the final turbine selected for implementation by ACED but will be limited to 140MW at the point of connection with the Eskom grid. The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.

The assessment of potential environmental impacts presented in this report is based on a preliminary layout of the turbines and associated infrastructure provided by ACED (Pty) Ltd. This layout includes 74 wind turbines as well as associated infrastructure. As mentioned, subsequent to the bird and bat monitoring surveys the turbine count has been reduced to 57 in response to assessments and specialist

[2] Initially 74 wind turbines were proposed but this has been reduced to 57 in response to assessments and specialist recommendations.

recommendations (this is discussed in detail in the Mitigation Section 8.5.1).

No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of medium to high significance were identified which require mitigation (thereafter the impacts can be reduced to medium – low significance). Mitigation to avoid impacts is primarily associated with the relocation (or in some instances, the elimination) of certain turbine positions of concern, as well as measures during the construction phase to prevent negative impacts from occurring. Removal and relocation mitigation has been implemented. Mitigations are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Programme (EMPr) included within Appendix N.

From the specialist investigations undertaken for the proposed Karusa Wind Farm development site, a number of potentially sensitive areas were identified (refer to **Figure 8.1**) where walk-through surveys are required to be undertaken to confirm the final placement of turbines and other associated infrastructure within these areas (including substation complex, access roads and power line routes).

No absolute environmental 'no go' areas were identified on the site. However, the following sensitive areas have been identified on the site:

» Habitats and vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 having elevated conservation value and, for that reason, has been classified here as having ecological and avifaunal sensitivity (for this site - important terrestrial habitats are **south-facing slopes** larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (rated as being of medium sensitivity).
» Areas classified as mountains, ridges or **steep slopes**: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).
» Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated

as having a probability of occurring in **natural habitats** within the study area.

» Perennial and non-perennial rivers, streams and watercourses. These support the ecosystems in the areas and may provide habitat for priority avifauna and foraging areas for bat species.
» Noise sensitive receptors (farmsteads on / around the site, albeit limited).
» Heritage artefacts (graves, stone walls and old buildings/ruins present on the site). (Note that no infrastructure is proposed on the identified heritage sites, but these features remain of heritage value and are sensitive to disturbance).
» Areas of high avifaunal sensitivity include rivers, streams, farm dams and slopes. Based on the results of the pre-construction bird monitoring twelve (12) wind turbines turbines (79, 81, 86, 90, 107, 110, 167, 173, 174, 178, 182 and 34 (lies in river buffer zone) fell within the high risk areas for avifauna. It was recommended that these turbines should be relocated to areas outside of the high risk areas as informed by the pre-construction bird monitoring study.
» Areas of high bat sensitivity also include, rivers, farm dams and slopes. No turbines occur in the areas of high bat sensitivity, however Turbine 118 did occur in the bats high sensitivity buffer (river, dam and slopes with buffer zones) and it was recommended that it should be relocated.

Should mitigation measures be adhered to, impacts on the identified sensitive areas can be adequately managed.

In response to the identified need to adequately manage impacts within sensitive areas identified on the site development footprint, and in order to demonstrate the ability of the project to adhere to recommended mitigation measures, the project developer has developed a best practice mitigation strategy with regards to the facility layout.

The EIA recommendations have been taken into account by the project developer, and the wind turbine layout has been refined to avoid the areas identified as being of high sensitivity. This refinement of the layout has resulted in the removal of turbines from the layout completely and the repositioning of turbines outside of identified sensitive areas. This refined layout shows a change in the number of wind turbines for the Karusa Wind Farm site from 74 to 57 (i.e. less turbines are proposed for construction within the Karusa Wind Farm). This refined layout considering the required mitigation measures is illustrated in Figure 8.2 and represents a positive outcome in terms of impact reduction and mitigation and the optimal layout for the facility.

Reflected in the revised map (Figure 8.2), a new logical numbering system has been applied to account for the reduction in turbine numbers and a distinction between the three phases of the broader project. As is evident from the revised layout and sensitivity map (refer to Figure 8.2) the layout adheres to the mitigation strategy having no wind turbines located in environmentally highly sensitive areas. Other additional minor movements to turbines to uphold energy generation efficiency were also required in order to accommodate the revision of turbine positions around environmental exclusion zones. This revised layout responding to the mitigation measures was shared with the specialist team, and letters and assessment reports have been obtained (and appended to this amended FEIR) in support of the layout revision. It is confirmed by the specialists that the layout which responds to the mitigation strategy is environmentally acceptable, and either reduces the impacts as originally assessed, or the impact significance ratings remain unchanged.

Letters from specialists confirming the acceptability of the revised layout are attached as Appendix T. The optimised layout is considered to address sensitivity issues raised through the EIA process, and is supported by the EAP and EIA specialist team for Environmental Authorisation.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

» There are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
» The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

The revised layout shown in Figure 8.2 is acceptable and the following conditions would be required to be included within an authorisation issued for the project:

- All mitigation measures detailed within this report and the specialist reports contained within Appendices F to S must be implemented.
- The draft Environmental Management Programme (EMPr) as contained within Appendix N of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed wind energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
- Following the final design of the facility, a revised layout must be submitted to DEA for review and approval prior to commencing with construction.
- Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
- A comprehensive search for threatened and near-threatened plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure if known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate infrastructure, a permit may be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.
- The final location of the wind turbines and associated infrastructure within identified sensitive areas (if any) must be informed by surveys undertaken by ecological and avifaunal specialists. The findings of these surveys must be included in the site-specific EMPr to be compiled for the project.
- Implement an operational phase monitoring programme to record the impact on bat species using the site.
- Implement an operational phase monitoring programme to record the impact on bird species using the site.
- Establish an on-going monitoring programme to detect, quantify and

remove any alien plant species that may become established.

» Adequate stormwater management measures to be put in place as the soils on the site may be prone to erosion due to shallow profiles and steep slopes.
» Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads).
» Plan the road and site layout in such a way as to make maximal use of existing roads and fence/border areas to minimise impacts and to keep grazing and natural units as intact as possible.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» Use of fire prevention and fire management strategies for the wind energy facility, to reduce risks to landowners.
» Implement a noise monitoring programme before the development of the wind energy facility. If needs be, quarterly noise monitoring should be conducted by an acoustic consultant for as long as noise complaints are registered.
» Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites (as detailed in the EMPr).

The heritage artefacts identified in the EIA must be cordoned / protected prior to the start of construction, to ensure that heritage sites are not destroyed. Applications for all other relevant and required permits if required to be obtained by ACED or the construction contractor must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to heritage sites, disturbance of protected vegetation, and disturbance to any riparian vegetation or wetlands.

Conclusions of the EIA: Phase 2: Soetwater Wind Farm

The Soetwater Wind Farm is proposed on the following farm portions (which collectively occupies land of 95.3 km^2 in extent):

» The remainder of and Portion 1, 2 and 4 of Farm Orange Fontein 203 and Annex Orange Fontein 185
» Farm Leeuwe Hoek 183
» Farm Zwanepoelshoek

The primary components of the Soetwater Wind Farm include up to 56 **wind turbines**, appropriately spaced to make use of the wind resource on the site. The generating capacity of the facility will depend on the final turbine selected for implementation but will be limited to 140MW at the point of connection with the Eskom grid. The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.

The assessment of potential environmental impacts presented in this report is based on a preliminary layout of the turbines and associated infrastructure provided by Soetwater Wind Farm (Pty) Ltd. This layout includes 56 wind turbines as well as associated infrastructure. Subsequent to the bird and bat monitoring surveys the turbine count has been repositions in response to assessments and specialist recommendations (this is discussed in detail in the Mitigation Section 10.5.1).

No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of medium to high significance were identified which require mitigation (thereafter the impacts can be reduced to medium – low significance). Mitigation to avoid impacts is primarily associated with the relocation (or in some instances, the elimination) of certain turbine positions of concern, as well as measures during the construction phase to prevent negative impacts from occurring. Relocation mitigation has been implemented. Mitigations are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental **Management Programme (EMPr)** included within **Appendix O**.

From the specialist investigations undertaken for the proposed Soetwater Wind Farm development site, a number of potentially sensitive areas were identified (refer to **Figure 10.1**) where walk-through surveys are required to be undertaken to confirm the final placement of turbines and other associated infrastructure within these areas (including substation complex, access roads and power line routes). No absolute environmental 'no go' areas were identified on the site. However, the following sensitive areas have identified on the site:

» Habitats and vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 having elevated conservation value and, for that reason, has been classified here as having ecological and avifaunal sensitivity (for this site - important terrestrial habitats that are **south-facing slopes** larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (rated as being of medium sensitivity). Areas classified as mountains, ridges or **steep slopes**: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).

» Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in **natural habitats** within the study area.
» Perennial and non-perennial rivers, streams and **watercourses**. These support the ecosystems in the areas and may provide habitat for priority avifauna species.
» Noise sensitive receptors (farmsteads on / around the site, albeit limited).
» Heritage artefacts (graves, stone walls and old buildings/ruins present on the site). (Note that no infrastructure is proposed on the identified heritage sites).
» Areas of high avifaunal sensitivity include rivers, streams, farm dams and slopes. Based on the results of the pre-construction bird monitoring five wind turbines (6, 20, 31, 28, 33) falls within the high risk areas for avifauna. These turbines should be relocated to areas outside of the high risk areas.
» Areas of high bat sensitivity also include rivers, farm dams and slopes. Two turbines (Turbines 34 and 111) occur in the moderate sensitivity buffer for bats. These turbines must acquire priority during pre/post-construction studies and mitigation measures, if any is needed.

Should mitigation measures be adhered to, impacts on the identified sensitive areas can be adequately managed.

In response to the identified need to adequately manage impacts within sensitive areas identified on the site development footprint, and in order to demonstrate the ability of the project to adhere to recommended mitigation measures, the project developer has developed as a best practice mitigation strategy with regards to the facility layout.

The EIA recommendations have been taken into account by the developer, and the wind turbine layout has been refined to avoid the sensitive areas. This layout considering the required mitigation measures is included in Figure 10.2, and represents the optimal layout for the facility. This refined layout shows a change in the location of the wind turbines.

Reflected in the revised map (Figure 10.2, a new logical numbering system has been applied to account for the reduction in turbine numbers and distinction between the three phases of the broader project. As is evident from the revised layout and sensitivity map (refer to Figure 10.2) the layout adheres to the mitigation strategy having no wind turbines located in environmentally sensitive areas. Other additional minor movements to turbines to uphold energy generation efficiency were also required in order to accommodate the revision of turbine positions around environmental exclusion zones. This revised layout responding to the mitigation measures was shared with the specialist team, and letters and assessment reports have been obtained (and appended to this amended FEIR) in support of the layout revision. It is confirmed by the specialists that the layout which responds to the mitigation strategy is environmentally acceptable, and either reduces the impacts as originally assessed, or the impact significance ratings remain unchanged.

Letters from specialists confirming the acceptability of the revised layout are attached as Appendix T. The optimised layout is considered to address the significant issues raised through the EIA process, and is supported by the EAP and EIA specialist team for Environmental Authorisation.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

» There are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
» The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**. The revised layout shown in Figure 8.2 is acceptable and the same condition which applies to Phase 1 applies to this phase of the project.

Conclusions of the EIA: Phase 3: Great Karoo Wind Farm

The Great Karoo Wind Farm is proposed on the following farm portions (which collectively occupies land of 91.8 km^2 in extent):

» Farm Kentucky 206

» Portion 1 of Farm Wolvenkop 207

The primary components of the Great Karoo Wind Farm include up to 57[3] **wind turbines**, appropriately spaced to make use of the wind resource on the site. The facility is proposed to have a generating capacity of up to 150 MW, used depending on the final turbine selected for implementation but will be limited to 140MW at the point of connection with the Eskom grid. . The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.

The assessment of potential environmental impacts presented in this report is based on a layout of the turbines and associated infrastructure provided by the developer. This layout includes 77 wind turbines as well as associated infrastructure. As mentioned, subsequent to the bird and bat monitoring surveys the turbine count has been reduced to 57 in response to assessments and specialist recommendations (this is discussed in detail in the Mitigation Section 12.5.1).

No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of medium to high significance were identified which require mitigation (thereafter the impacts can be reduced to medium – low significance). Mitigation to avoid impacts is primarily associated with the relocation (or in some instances, the elimination) of certain turbine positions of concern, as well as measures during the construction phase to prevent negative impacts from occurring. Removal and relocation mitigation has been implemented. Mitigations are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental **Management Programme (EMPr)** included within **Appendix P**.

From the specialist investigations undertaken for the proposed Karusa Wind Farm development site, a number of potentially sensitive areas were identified (refer to **Figure 12.1**) where walk-through surveys are required to be undertaken to confirm the final placement of turbines and other associated infrastructure within these areas (including substation complex, access roads and power line routes). No absolute environmental 'no go' areas were identified on the site. However, the following sensitive areas have identified on the site:

» Vegetation of conservation importance: this is based primarily on the location of the site within

[3] Initially 77 wind turbines were proposed but this has been reduced to 57 in response to assessments and specialist recommendations

the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 (for this site - important terrestrial habitats that are **south-facing slopes** larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (medium sensitivity). Areas classified as mountains, ridges or **steep slopes**: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).

» Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in **natural habitats** within the study area.
» Perennial and non-perennial rivers, streams and **watercourses**. These support the ecosystems in the areas and may provide habitat for priority avifauna species.
» Noise sensitive receptors (farmsteads on / around the site, albeit limited).
» Heritage artefacts (graves, stone walls and old buildings/ruins present on the site). (Note that no infrastructure is proposed on the identified heritage sites).
» Areas of high avifaunal sensitivity include rivers, streams, farm dams and slopes. Based on the results of the pre-construction bird monitoring (4) wind turbines (75, 76, 149 and 154) falls within the high risk areas for avifauna
» Areas of high bat sensitivity also include rivers, farm dams and slopes. One turbine (125) occurs in the moderate sensitivity buffer for bats.

Should mitigation measures be adhered to, impacts on the identified sensitive areas can be adequately managed.

In response to the identified need to adequately manage impacts within sensitive areas identified on the site development footprint, and in order to demonstrate the ability of the project to adhere to recommended mitigation measures, the project developer has developed as a best practice mitigation strategy with regards to the facility layout.

The EIA recommendations have been taken into account by the project developer, and the wind turbine layout has been refined to avoid the areas identified as being of high sensitivity. This refinement of the layout has resulted in the removal of turbines from the layout completely and the repositioning of turbines outside of identified sensitive areas. This layout considering the required mitigation measures is included in Figure 12.2, and represents the optimal layout for

the facility. This refined layout shows a change in wind turbines from 77 to 57.
In response to the identified need to adequately manage impacts within sensitive areas identified on the site development footprint, and in order to demonstrate the ability of the project to adhere to recommended mitigation measures, the project developer has developed as a best practice mitigation strategy with regards to the facility layout.

The EIA recommendations have been taken into account by the project developer, and the wind turbine layout has been refined to avoid the areas identified as being of high sensitivity. This refinement of the layout has resulted in the removal of turbines from the layout completely and the repositioning of turbines outside of identified sensitive areas. This layout considering the required mitigation measures is included in Figure 12.2, and represents the optimal layout for the facility. This refined layout shows a change in wind turbines from 77 to 57.

The refined layout now has a reduced number of wind turbines for the Great Karoo Wind Farm site. The turbines have been reduced from 77 to 57. (i.e. 20 less turbines are proposed for construction within the Great Karoo Wind Farm).

Reflected in the revised map (Figure 12.2, a new logical numbering system has been applied to account for the reduction in turbine numbers and distinction between the three phases of the broader project. As is evident from the revised layout and sensitivity map (refer to Figure 12.2) the revised/optimised layout adheres to the mitigation strategy having no wind turbines located in environmentally sensitive areas. Other additional minor movements to turbines to uphold energy generation efficiency were also required in order to accommodate the revision of turbine positions around environmental exclusion zones. The revised layout responding to the mitigation measures was shared with the specialist team, and letters and assessment reports have been obtained (and appended to this amended FEIR) in support of the layout revision. It is confirmed by the specialists that the layout which responds to the mitigation strategy is environmentally acceptable, and either reduces the impacts as originally assessed, or the impact significance ratings remain unchanged.

Letters from specialists confirming the acceptability of the revised layout are attached as Appendix T. The optimised layout is considered to address the significant issues raised through the EIA process, and is supported by the EAP and EIA specialist team for Environmental Authorisation.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

» There are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
» The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

<u>The revised layout shown in Figure 12.2 is acceptable and the same condition which applies to Phase 1 applies to this phase of the project.</u>

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APPENDICES

ABBREVIATIONS AND ACRONYMS

BID	Background Information Document
CBOs	Community Based Organisations
CDM	Clean Development Mechanism
CO_2	Carbon dioxide
D	Diameter of the rotor blades
DEA	National Department of Environmental Affairs
DMR	Department of Mineral Resources
DOT	Department of Transport
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GIS	Geographical Information Systems
GG	Government Gazette
GN	Government Notice
GWh	Giga Watt Hour
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IEP	Integrated Energy Planning
km^2	Square kilometres
km/hr	Kilometres per hour
kV	Kilovolt
LUPO	Rezoning and Subdivision in terms of Land Use Planning Ordinance, Ordinance 15 of 1985
m^2	Square meters
m/s	Meters per second
MW	Mega Watt
NEMA	National Environmental Management Act (Act No 107 of 1998)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (Act No 25 of 1999)
NGOs	Non-Governmental Organisations
NIRP	National Integrated Resource Planning
NC DENC	Northern Cape Department of Environment and Nature Conservation
NWA	National Water Act (Act No 36 of 1998)
PGWC	Provincial Government of the Western Cape
REIPPP	Renewable Energy Independents Power Producer Procurement Programme
REDZ	Renewable Energy Development Zones
SAHRA	South African Heritage Resources Agency
SKA	Square Kilometre Array
SANRAL	South African National Roads Agency Limited
SDF	Spatial Development Framework
SIA	Social Impact Assessment

DEFINITIONS AND TERMINOLOGY

Alternatives: Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the 'do nothing' alternative.

Ambient sound level: The reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

Archaeological material: Remains resulting from human activities which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

Article 3.1 (*sensu* Ramsar Convention on Wetlands): "Contracting Parties "shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory"".(Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (see http://www.ramsar.org/)

Betz Limit: It is the flow of air over the blades and through the rotor area that makes a wind turbine function. The wind turbine extracts energy by slowing the wind down. The theoretical maximum amount of energy in the wind that can be collected by a wind turbine's rotor is approximately 59%. This value is known as the Betz Limit.

Calcrete: A soft sandy calcium carbonate rock related to limestone which often forms in arid areas.

Clean Development Mechanism (CDM): An arrangement under the Kyoto Protocol allowing industrialised countries with a greenhouse gas reduction commitment (called Annex 1 countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. The most important factor of a CDM project is that it establishes that it would not have occurred without the additional incentive provided by emission reductions credits. The CDM allows net global greenhouse gas emissions to be reduced at a much lower global cost by financing emissions reduction projects in developing countries where costs are lower than in industrialised countries. The CDM is supervised by the CDM Executive Board (CDM EB) and is under the guidance of the Conference of the Parties (COP/MOP) of the United Nations

Framework Convention on Climate Change (UNFCCC) (refer http://unfccc.int/kyoto_protocol/mechanisms/items/2998.php).

Cumulative impacts: Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients and heated water to a river that combine to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

Cut-in speed: The minimum wind speed at which the wind turbine will generate usable power.

Cut-out speed: The wind speed at which shut down occurs.

Direct impacts: Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable

Disturbing noise: A noise level that exceeds the ambient sound level measured continuously at the same measuring point by 7 dB or more.

'Do nothing' alternative: The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

Early Stone Age: A very early period of human development dating between 300 000 and 2.6 million years ago.

Endangered species: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Endemic: An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

Energy utilisation factor (EUF): The percentage of actual generation compared to the total possible installed generation annually.

Environment: the surroundings within which humans exist and that are made up of:

i. the land, water and atmosphere of the earth;
ii. micro-organisms, plant and animal life;
iii. any part or combination of (i) and (ii) and the interrelationships among and between them; and
iv. the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental Impact: An action or series of actions that have an effect on the environment.

Environmental impact assessment: Environmental Impact Assessment (EIA), as defined in the NEMA EIA Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

Environmental management: Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental management Programme: An operational plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its on-going maintenance after implementation.

Fossil: Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Generator: The generator is what converts the turning motion of a wind turbine's blades into electricity

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000).

Indigenous: All biological organisms that occurred naturally within the study area prior to 1800

Indirect impacts: Indirect or induced changes that may occur as a result of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

Interested and Affected Party: Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.

Late Stone Age (LSA): In South Africa this time period represents fully modern people who were the ancestors of southern African KhoeKhoen and San groups (40 000 – 300 years ago).

“Micro-siting”: An international convention with regards to wind energy facilities. It refers to the process of specifically determining the position of each turbine based on the wind resource and topographical constraints in order to maximise production.

Middle Stone Age (MSA): An early period in human history characterised by the development of early human forms into modern humans capable of abstract though process and cognition 300 000 – 40 000 years ago.

Miocene: A geological time period (of 23 million - 5 million years ago).

Nacelle: The nacelle contains the generator, control equipment, gearbox and anemometer for monitoring the wind speed and direction.

National Integrated Resource Plan (NIRP): Commissioned by NERSA in response to the National Energy Policy’s objective relating to affordable energy services, in order to provide a long-term, cost-effective resource plan for meeting electricity demand, which is consistent with reliable electricity supply and environmental, social and economic policies.

Natural properties of an ecosystem (*sensu* Convention on Wetlands): Defined in Handbook 1 as the "...physical, biological or chemical components, such as soil, water, plants, animals and nutrients, and the interactions between them". (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd

Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (see http://www.ramsar.org/)

Palaeontological: Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Pleistocene: A geological time period (of 3 million – 20 000 years ago).

Pliocene: A geological time period (of 5 million – 3 million years ago).

Ramsar Convention on Wetlands: "The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". As of March 2004, 138 nations have joined the Convention as Contracting Parties, and more than 1300 wetlands around the world, covering almost 120 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance." (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (refer http://www.ramsar.org/). South Africa is a Contracting Party to the Convention.

Rare species: Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare".

Red data species: Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

Rotor: The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor converts the energy in the wind into rotational energy to turn the generator. The rotor has three blades that rotate at a constant speed of about 15 to 28 revolutions per minute (rpm).

Significant impact: An impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.

Sustainable Utilisation (*sensu* Convention on Wetlands): Defined in Handbook 1 as the "human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations". (Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (refer http://www.ramsar.org/).

Structure (historic): Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those which are over 60 years old.

Tower: The tower, which supports the rotor, is constructed from tubular steel. The nacelle and the rotor are attached to the top of the tower. The tower on which a wind turbine is mounted is not just a support structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. The tower must be strong enough to support the wind turbine and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

Wind power: A measure of the energy available in the wind.

Wind rose: The term given to the diagrammatic representation of joint wind speed and direction distribution at a particular location. The length of time that the wind comes from a particular sector is shown by the length of the spoke, and the speed is shown by the thickness of the spoke.

Wind speed: The rate at which air flows past a point above the earth's surface.

Wise Use (*sensu* Convention on Wetlands): Defined in Handbook 1 (citing the third meeting of the Conference of Contracting Parties (Regina, Canada, 27 May to 5 June 1987) as "the wise use of wetlands is their sustainable utilisation for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem".(Ramsar Convention Secretariat. 2004. Ramsar handbooks for the wise use of wetlands. 2nd Edition. Handbook 1. Ramsar Convention Secretariat, Gland, Switzerland.) (see http://www.ramsar.org/)

INTRODUCTION CHAPTER 1

African Clean Energy Developments (Pty) Ltd (ACED) under three special purpose vehicle's (SPV's) is proposing to establish three commercial wind energy facilities and associated infrastructure on a site located within the Karoo Hoogland Local Municipality (approximately 30 km south of Sutherland in the Northern Cape Province). A combined site has been identified for consideration within an Environmental Impact Assessment (EIA) and this amended final report is submitted after taking account of feedback received from the Department of Environmental Affairs on the initial report submitted in final form in 2012. Up to 207[4] wind turbines were proposed to be constructed across three separate phases over an area of approximately 340 km^2 in extent. This has subsequently been reduced to 170 wind turbines in response to EIA specialist recommendations and is described in the conclusions chapters for each phase and this revised layout is supported by letters provided by the EIA specialists. Associated infrastructure includes substations, workshops, control and administration and security facilities, access roads and power lines associated with each phase of the project. Three project development phases are proposed, namely:

» Phase 1: Proposed Karusa Wind Farm
» Phase 2: Proposed Soetwater Wind Farm
» Phase 3: Proposed Great Karoo Wind Farm

The nature and extent of the full extent of the wind energy facility (i.e. the three development phases), as well as potential environmental impacts associated with the construction and operation of a facility of this nature are assessed in this Environmental Impact Assessment (EIA) Report. This EIA Report consists of the following sections:

» **Chapter 1** provides background to the proposed Wind Energy Facility project and the environmental impact assessment
» **Chapter 2** describes the activities associated with the project (project scope).

[4] The following minor amendments to the project information have been made:

» One turbine was erroneously included in Phase 2 which is now included into Phase 1. Therefore, Phase 1 originally had 75 turbines, and now has 74 turbines. Phase 2 originally had 55 turbines, and now has 56 turbines.
» The numbering of turbines as indicated in the maps within the main EIA report (only) has changed. However, the locations of the turbines have not changed and the layout remains the same) as presented in the draft and final EIA published in 2012(apart from re-numbering of the turbines). The number of wind turbines for all three phases remains as 207 in total.

» **Chapter 3** This chapter describes wind energy as a power option and provides insight to technologies for wind turbines
» **Chapter 4** outlines the regulatory and legal context of the EIA study
» **Chapter 5** outlines the process which was followed during the EIA Phase of the project, including the consultation program that was undertaken
» **Chapter 6** describes the existing biophysical and socio-economic environment
» **Chapter 7** describes the assessment of environmental impacts associated with the proposed **Phase 1: Karusa Wind Farm**.
» **Chapter 8** presents the conclusions of the impact assessments as well as impact statements for the proposed **Phase 1: Karusa Wind Farm**.
» **Chapter 9** describes the assessment of environmental impacts associated with the proposed **Phase 2: Soetwater Wind Farm**.
» **Chapter 10** presents the conclusions of the impact assessments as well as impact statements for the proposed **Phase 2: Soetwater Wind Farm**
» **Chapter 11** describes the assessment of environmental impacts associated with the proposed **Phase 3: Great Karoo Wind Farm**.
» **Chapter 12** presents the conclusions of the impact assessments as well as impact statements for the proposed **Phase 3: Great Karoo Wind Farm**.
» **Chapter 13** contains a list references for the EIA report and specialist reports

1.1. Purpose of the Amended Final EIA Report

The EIA process for the Hidden Valley Wind Energy Facility commenced in August 2011. A draft Environmental Impact Assessment Report was released for public review in March 2012. Thereafter, the final EIA report was submitted to DEA in April 2012. In May 2013 DEA requested the following:

» The applicant to appoint specialists to conduct pre-construction bird and bat monitoring.
» The EAP to amend the Final EIA report by including the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes.
» Allow registered I&APS an opportunity to comment on the amended Final EIA Report.
» Resubmit the amended Final EIA Report together with any comments received from registered I&APs to DEA for final decision-making.

Therefore, the purpose of this amended Final EIA Report for the Hidden Valley Wind Energy Facility is to include the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes. In addition the following minor amendments to the project description have been made:

» One turbine was erroneously included in the Phase 2 original layout which is was corrected and included into Phase 1. Therefore in the original layout, Phase 1 originally had 75 turbines, and now has 74 turbines. Phase 2 originally had 55 turbines, and now has 56 turbines.
» The numbering of turbines as indicated in the maps within the main EIA report (only) has changed. However, the locations of the turbines have not changed and the layout remains the same) as presented in the draft and final EIA published in 2012(apart from re-numbering of the turbines).
» The number of turbines submitted for Authorisation has been reduced from 207 to 170 turbines across all three separate phases – 57 turbines on Karusa, 57 turbines on Soetwater and 56 turbines on Great Karoo. This has been done in response to assessments and specialist recommendations (now including the pre-construction bird and bat monitoring programmes and stakeholder comments) and is described in the conclusions chapters for each phase and supported by letters provided by the EIA specialists.
» Inclusion of a double-circuit power line up to 12km in length from the on-site substation to Komsberg Substation, all located within the project development footprint assessed through the EIA, in response to the grid connection option given to this project by Eskom (via the cost-estimate letter provided by Eskom for this project).

The amended Final EIA report has been now been complied and is available for public review by all stakeholders and registered I&APs prior to the submission to the National Department of Environmental Affairs.

1.2. Project Components

ACED is proposing to establish three wind energy facilities (with associated infrastructure) on a site located within the Karoo Hoogland Local Municipality. The combined site identified for consideration within an Environmental Impact Assessment (EIA) is within the Northern Cape Province, and lies approximately 30 km south of Sutherland (Northern Cape) and 30 km north of Matjiesfontein (Western Cape). Up to **207 wind turbines** (74 turbines for Phase 1, 56 turbines for Phase 2 and 77 turbines for Phase 3) were proposed to be constructed over the extent of a larger area of approximately 340 km^2 in extent but as mentioned above this has been reduced to 170 in response to assessments and specialist recommendations. The generation capacity of the facility will depend on the turbine choice selected by ACED but will be limited to a maximum of 140MW (measured at the point of connection to the Eskom grid) per phase. The larger project development area is proposed to be developed in a three-phased approach. As each phase of the project will be constructed and operated by a separate Special Purpose Vehicle, separate Environmental Authorisations will be required to be obtained. As such, each phase of this project has been registered with the National DEA under following project names and application reference numbers:

» Phase 1: Proposed Karusa Wind Farm (DEA Ref. No: 12/12/20/2370/1)
» Phase 2: Proposed Soetwater Wind Farm (DEA Ref. No: 12/12/20/2370/2)
» Phase 3: Proposed Great Karoo Wind Farm (DEA Ref. No: 12/12/20/2370/3)

The extents of each of these three phases are shown in **Figure 1.1**. As the three phases are proposed to form part of a larger wind energy facility development, a consolidated EIA process has been undertaken (with a single EIA report being produced) to assess the potential environmental impacts associated with each phase of the development, as well as the potential cumulative impacts of all three phases. A single public participation process was undertaken to provide details on and the opportunity for stakeholders to comment on all three phases of the development. This approach as followed originally in 2011 and 2012 has been retained in this 2014 report. The details pertaining to each phase of the project is provided in **Table 1.1** overleaf.

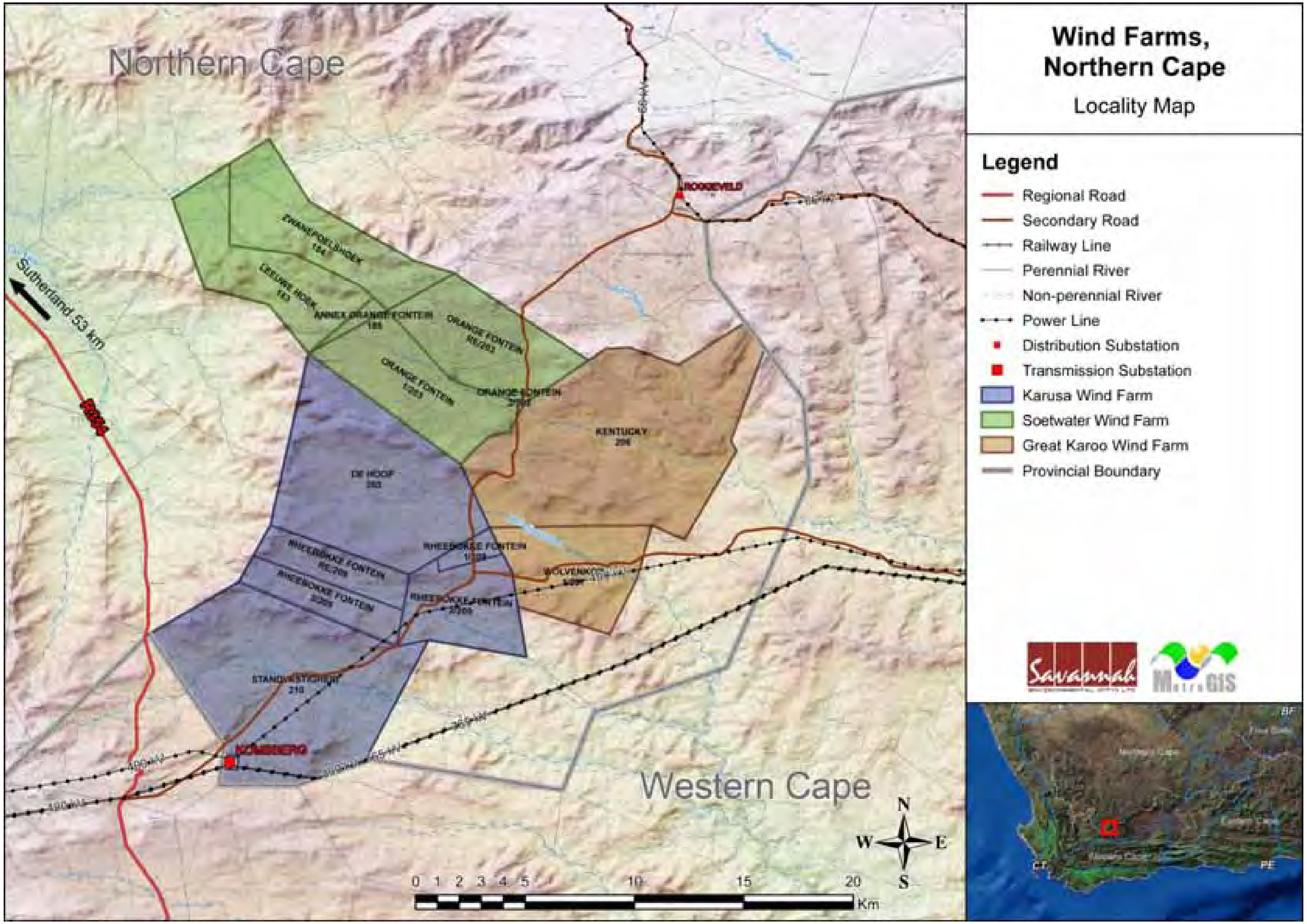

Figure 1.1: Locality map showing the proposed area for the establishment of the Hidden Valley Wind Energy Facility and the areas covered by each phase of the development of the project

Table 1.1: Project Information for the Three Phases of the Hidden Valley Wind Energy Facility

No.	Information	Phase 1- Karusa Wind Farm	Phase 2 - Soetwater Wind Farm	Phase 3 - Great Karoo Wind Farm
1.	Applicant (SPV)	ACED Renewables Hidden Valley (Pty) Ltd	Soetwater Wind Farm (Pty) Ltd	Great Karoo Wind Farm (Pty) Ltd
2.	DEA Reference Number	12/12/20/2370/1	12/12/20/2370/2	12/12/20/2370/3
3.	Descriptions of affected farm portions	» Farm De Hoop 202 » Farm Standvastigheid 210 » Portion 1, 2, 3 and the remainder of Farm Rheebokke Fontein 209	» The remainder of, and Portions 1, 2 and 4 of Farm Orange Fontein 203, Annex Orange Fontein 185 » Farm Leeuwe Hoek 183 » Farm Zwanepoelshoek 184	» Farm Kentucky 206 » Portion 1 of Farm Wolvenkop 207
4.	Size of the site	136.2 km^2	95.3 km^2	91.8 km^2
5.	21 digit Surveyor General codes of all affected farm portions	» C07200000000020200000 » C07200000000020900000 » C07200000000020900001 » C07200000000021000000 » C07200000000020900002 » C07200000000020900003	» C07200000000020300000 » C07200000000020300001 » C07200000000020300002 » C07200000000018300000 » C07200000000018500000 » C07200000000020300004 » C07200000000018400000	» C07200000000020600000 » C07200000000020700001
6.	Substation complex	One (1) up to 400 kV substation, workshop, control, administration and security facilities	One (1) 132 kV substation, workshop, control, administration and security facilities	One (1) 132 kV substation, workshop, control, administration and security facilities
7.	Power line (number and voltage)	Overhead power line between the new on-site substation and the existing Droerivier / Komsberg 2 400kV power line or Komsberg substation as might be directed by Eskom.	One 132 kV power line between the new on-site substation and the proposed substation (located on the Karusa Wind Farm).	One 132 kV power line between the new on-site substation and the proposed substation (located on the Karusa Wind Farm).
8.	Access road and width	Up to 8 m wide, up to 38 km in length	Up to 8 m wide, up to 28 km in length	Up to 8 m wide, up to 39 km in length
9.	Proposed number of wind turbines	74	56	77
10.	Revised number of turbines after mitigation plan	57	56	57

1.3. The Purpose of the Proposed Project

Globally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as exploitation of non-renewable resources. In order to meet the long-term goal of a sustainable renewable energy industry and to diversify the energy-generation mix in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, ACED proposes the establishment of the Hidden Valley Wind Energy Facility to add new capacity to the national electricity grid. <u>ACED intend to bid the three phases as separate projects to the Department of Energy (DoE) under the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme.</u> ACED will be required to apply for a generation license from the National Energy Regulator of South Africa (NERSA), as well as a power purchase agreement from Eskom (i.e. typically for a period of 20 years) in order to build and operate the proposed wind energy facility. As part of the agreement, ACED will be remunerated per kWh by Eskom who will be financially backed by government. Depending on the economic conditions following the lapse of this period, the facility can either be decommissioned or the power purchase agreement may be renegotiated and extended.

1.4. Overview of Wind Energy Facility Development

Wind turbines use the energy from the wind to generate electricity. In essence, the blades of the turbine are turned by the wind and the energy captured is converted into electrical energy and supplied to the electricity grid for use in homes and elsewhere.

The overarching objective for the wind energy facility planning process is to maximise electricity production through **exposure to the wind resource**, while minimising infrastructure, operational and maintenance costs, as well as **social and environmental impacts**. The development should also aim to minimise pressure on the surrounding environment, without threatening the natural area or any conservation measures, in line with national legislation.

Local level issues are now being considered within **site-specific studies** and assessment through the EIA process in order to delineate areas of sensitivity within the broader area. A scoping study was conducted in 2011 and accepted by DEA in February 2011. The scoping report identified areas of potential environmental sensitivity to inform the design of the wind energy facility, these sensitive areas are shown in **Figure 1.2 – Figure 1.4** and included:

» Pockets of vegetation on the site are classified in the Namakwa District Biodiversity Sector Plan (NDBSP) as being a T2[5] Critical Biodiversity Area (CBA).
» Parts of the site occur on the Hantam-Roggeveld Centre of Endemism (HRC).
» The site occurs in the Cape Floristic Region and could support populations of Red List fauna and flora that have been evaluated as having a probability of occurring in natural habitats within the study area.
» Perennial and non-perennial rivers, streams and watercourses occur on the site (it is recommended that a buffer of 32 metres from the watercourse be applied as a constrained area in the layout of the facility).
» Areas classified as mountains, ridges or steep slopes: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance have been identified as important biodiversity habitats.
» Potential avifaunal sensitive areas/ habitats.

A layout of the components of the wind energy facility has been developed by ACED for assessment in this EIA report. Specialist software is available to assist developers in selecting the optimum position for each turbine before the project is constructed. This layout will then inform the positioning of other infrastructure such as the internal substation and access roads.

The scope of the proposed Hidden Valley Wind Energy Facility project, including details of all elements of the project for each of the three development phases (for the construction, operation and decommissioning phases) is discussed in more detail in Chapter 2.

[5] (EN (Endangered) and VU (Vulnerable) vegetation types, important terrestrial habitats (e.g. quartz patches, steep, south-facing slopes larger than 25 ha in size, kloofs, habitat for riverine rabbit), other important biodiversity areas that do not fall into T1).

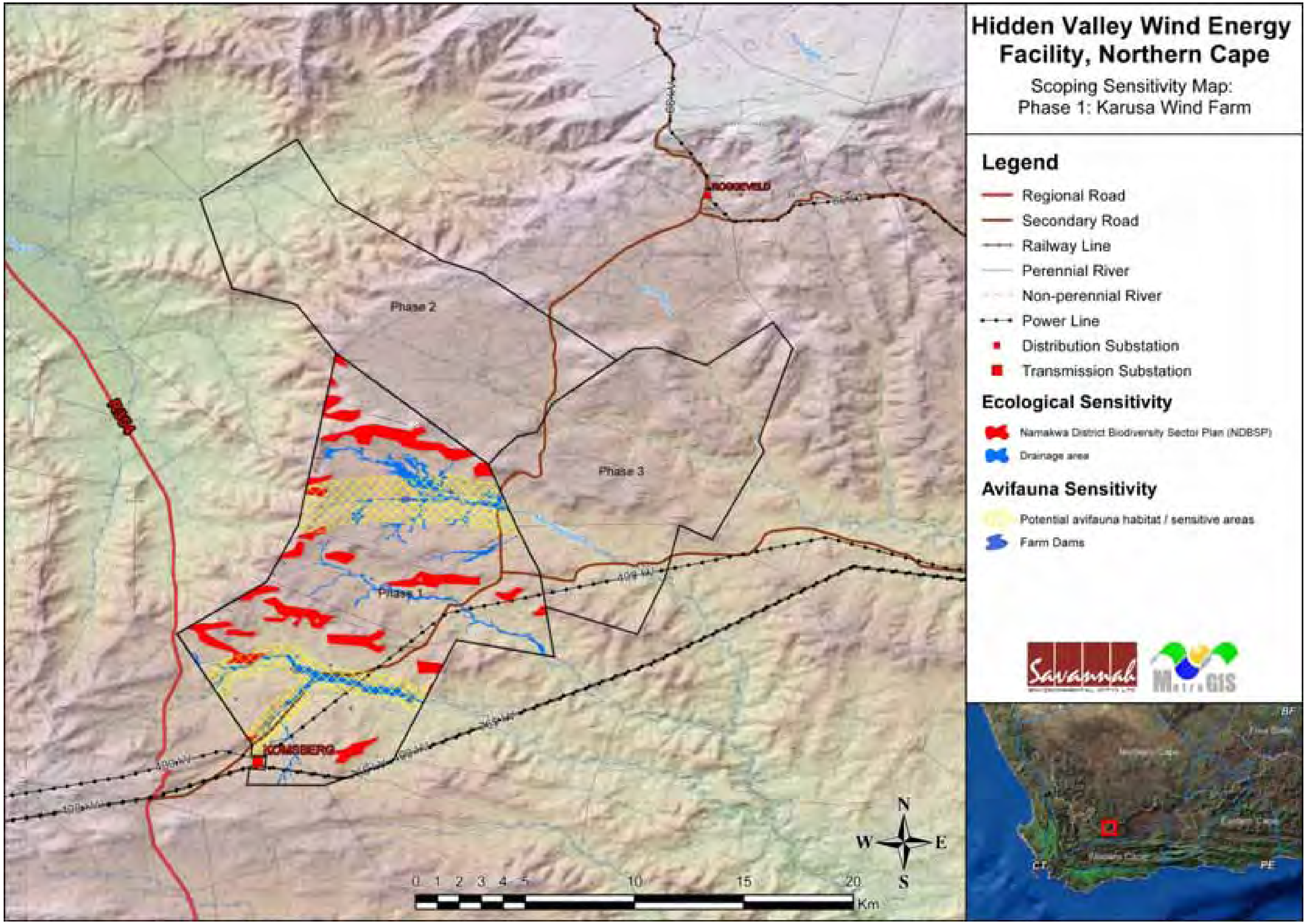

Figure 1.2: Scoping Study and Desktop Environmental Sensitivity Map for the proposed Phase 1: Karusa Wind Farm

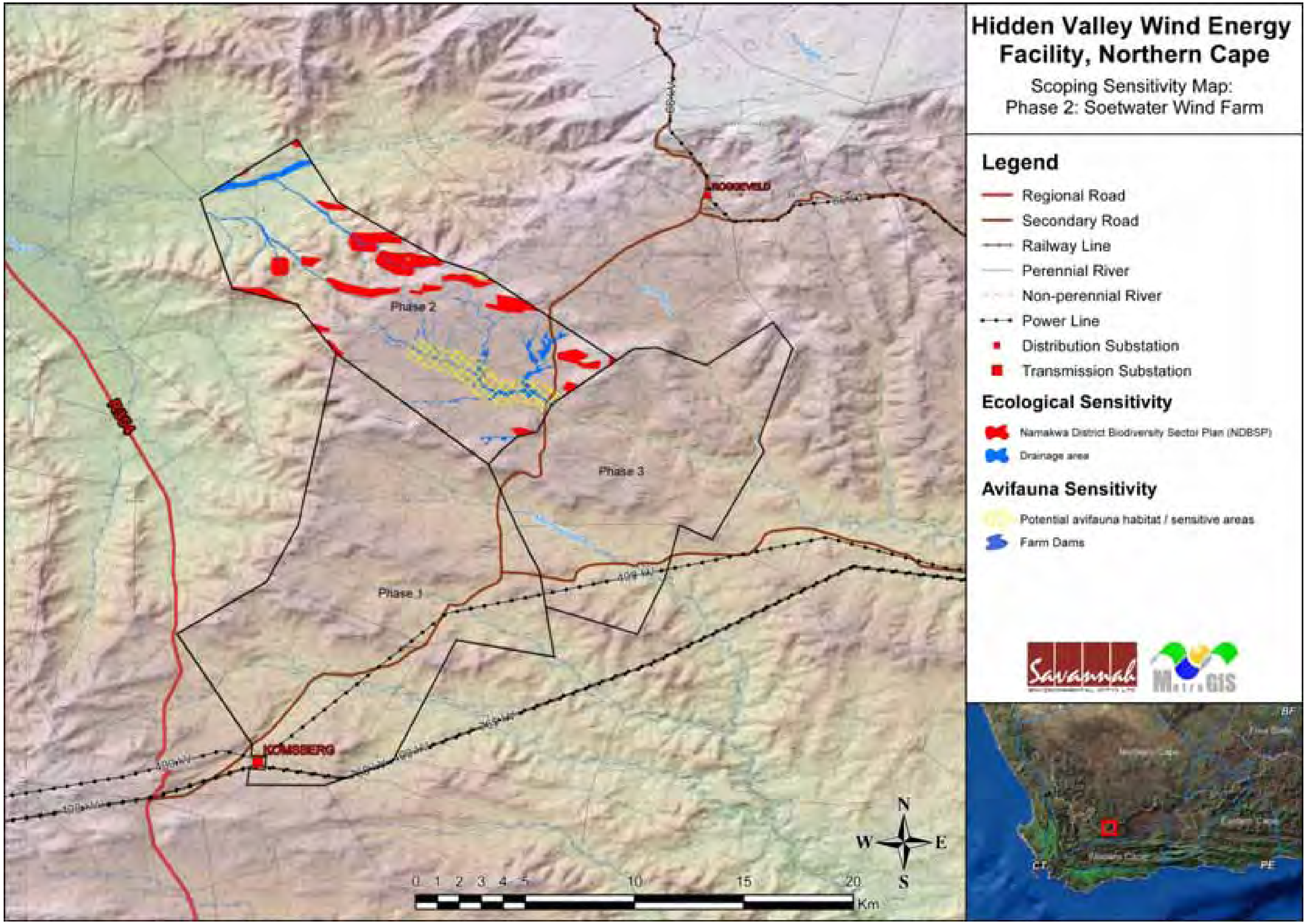

Figure 1.3: Scoping Study and Desktop Environmental Sensitivity Map for the proposed Phase 2: Soetwater Wind Farm

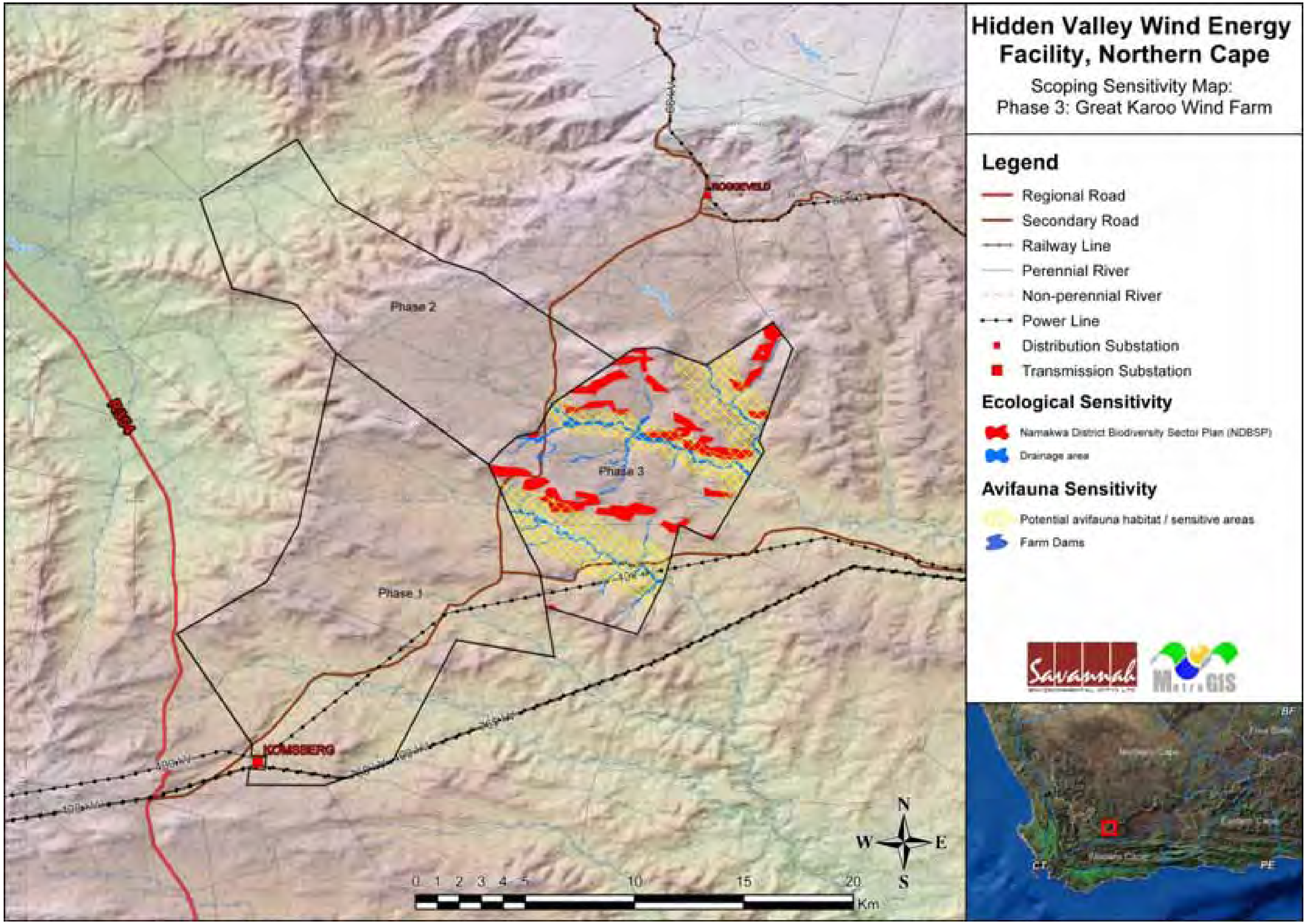

Figure 1.4: Scoping Study and Desktop Environmental Sensitivity Map for the proposed Phase 3: Great Karoo Wind Farm

1.5. Requirement for an Environmental Impact Assessment Process

The proposed project is subject to the requirements of the Environmental Impact Assessment Regulations (EIA Regulations) of June 2010 published in terms of Section 24(5) of the National Environmental Management Act (NEMA, No 107 of 1998). This section provides a brief overview of EIA Regulations of June 2010 and their application to this project.

NEMA is national legislation that provides for the authorisation of certain controlled activities known as "listed activities". In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. The National Department of Environmental Affairs (DEA) is the competent authority for this project. An application for authorisation has been accepted by the DEA (under Application Reference numbers: **12/12/20/2370/1**, **12/12/20/2370/2 and 12/12/20/2370/3**). Separate environmental authorisations will be granted for each project. Through the decision-making process, the DEA will be supported by the Northern Cape Department of Environment and Nature Conservation (NC DENC), as the commenting authority.

The need to comply with the requirements of the EIA Regulations ensures that decision-makers are provided the opportunity to consider the potential environmental impacts of a project early in the project development process, and assess if environmental impacts can be avoided, minimised or mitigated to acceptable levels. Comprehensive, independent environmental studies are required to be undertaken in accordance with the EIA Regulations to provide the competent authority with sufficient information in order for an informed decision to be taken regarding the project. ACED has appointed Savannah Environmental (Pty) Ltd to conduct the independent Environmental Impact Assessment (EIA) process for all phases of the proposed project.

An EIA is also an effective planning and decision-making tool for the project proponent. It allows the environmental consequences resulting from a technical facility during its establishment and its operation to be identified and appropriately managed. It provides the opportunity for the developer to be forewarned of potential environmental issues, and allows for resolution of the issue(s) reported on in the Scoping and EIA reports as well as dialogue with affected parties.

In terms of sections 24 and 24D of NEMA, as read with Government Notices 543, 544 and 545 and 546 (as amended), a Scoping and EIA are required to be undertaken for this proposed project. The listed activities in terms of GN 544, 545 and 546 as listed below are relevant to each of the three phases (and so not repeated for each project), and application has been made for each of the listed activities below for each project development phase:

Number and date of relevant notice:	Activity No(s) (in terms of the relevant notice) :	Description of Listed Activity	Description of the Relevant Component(s) of Facility
GN544	10 (b)	The construction of facilities or infrastructure for the transmission and distribution of electricity – (a) Outside urban areas or industrial complexes with a capacity of more than 33kV but less than 275kV	The project will entail construction of substations and power lines up to 400kV (outside an urban area).
GN544	11 (iii, vi, x and x)	-The construction of: (v) weirs; (vi) bulk stormwater outlet structures; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more Where such construction occurs within a watercourse or within 32 metres of a watercourse, measures from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	The wind energy facility will include the construction of infrastructure (including power lines, access roads, storm water structures and buildings) within 32m of a watercourse.
GN544	13	The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres.	The wind energy facility will require facilities for storage of fuels / oils that are up to 500m^{3}in capacity.
GN544	18 (i)	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock or more than 5 cubic metres from: (i) a watercourse	Construction will entail excavations and/or backfilling of more than 5 m^3 from/into watercourses. This is relevant during the construction phase when crossing on-site watercourse with access roads.
GN544	22 (ii)	The construction of a road, outside urban areas,	The wind energy facility will require access roads to be constructed (up to

Number and date of relevant notice:	Activity No(s) (in terms of the relevant notice) :	Description of Listed Activity	Description of the Relevant Component(s) of Facility
		–(ii) where no road reserve exists where the road is wider than 8 metres	8m wide), based on the design of the facility (~ 30km of access road for each phase)
GN544	47 (ii)	The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre – (ii) where no reserve exists, where the existing road is wider than 8 metres	Existing farm (gravel) access roads will be widened up to 8m in width and will be longer than 1 km in length (~ 30km of access road for each phase).
GN545	1	The construction of facilities or infrastructure, for the generation of electricity where the output is 20 megawatts or more.	The wind energy facility will consist of wind turbines for electricity generation of more than 20MW. Power lines and substations together with workshops, control, administration and security buildings are ancillary infrastructure for this energy generation process.
GN545	15	Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more	The site for the proposed wind energy facility is currently used for livestock farming, and the footprint of the facility will be transformed to special use (wind farm, or "industrial use") on an area greater than 20 hectares.
GN546	12 (a) & (b)	The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (a) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004 (b) Within critical biodiversity areas identified in bioregional plans	The site falls within the Hantam Centre of Endemism in the Northern Cape, and will result in the clearance of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation within the development footprint of the wind turbines and associated infrastructure.
GN546	4 (a) ii (ee)	The construction of a road wider than 4 metres with a reserve less than 13,5 metres in the Northern Cape and outside an urban area. in a: (ee) Critical biodiversity areas as	The site occurs in a rural area within the Northern Cape and the Hantam Centre of Endemism and will result in the construction of access roads within the site will be up to 8 metres wide.

Number and date of relevant notice:	**Activity No(s) (in terms of the relevant notice) :**	**Description of Listed Activity**	**Description of the Relevant Component(s) of Facility**
		identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.	
GN546	10 (a) (ee) (ii)	The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres, in the Northern Cape Province (ii) outside urban areas in: (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ii) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined.	The wind energy facility will require facilities for storage of fuels / oils up to $500m^3$. The site occurs in a rural part of the Northern Cape within the Hantam Centre of Endemism . In addition, the storage of dangerous goods in containers may occur within 100 metres of a water courses.

This report documents the evaluation of the potential environmental impacts of the proposed construction and operation of each of the three development phases of the wind energy facility, as proposed by ACED. This study forms part of the EIA process and was conducted in accordance with the requirements of the EIA Regulations in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998).

1.6. Objectives of the Environmental Impact Assessment Process

The Scoping Phase of the EIA process refers to the process of identifying potential issues associated with the proposed project, and defining the extent of studies required within the EIA Phase. This was achieved through an evaluation of the proposed project in order to identify and describe potential environmental impacts. The Scoping Phase included input from the project proponent, specialists with experience in the study area as well as in EIAs for similar projects, as well as a public consultation process with key stakeholders that included both government authorities and interested and affected parties (I&APs).

The EIA Phase addressed those identified potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with all phases of the project including design, construction, operation and decommissioning, and recommends appropriate mitigation measures for potentially significant environmental impacts. This amended Final EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project, and has been amended to specifically include the findings of the pre-construction bird and bat monitoring programmes.

The release of this amended Final EIA Report for public review for a 21-days provides stakeholders and registered I&APs with an opportunity to review the new information included in this report. The amended final EIA Report to DEA will incorporate all issues and responses raised during the public review of the rrreport prior to submission to DEA.

1.7. Details of Environmental Assessment Practitioner and Expertise to conduct the Scoping and EIA

Savannah Environmental was contracted by ACED as the independent environmental consultant to undertake both Scoping and EIA processes for the proposed project. Neither Savannah Environmental nor any of its specialist sub-consultants on this project are subsidiaries of or are affiliated to ACED. Furthermore, Savannah Environmental does not have any interests in secondary developments that may arise out of the authorisation of the proposed project.

Savannah Environmental is a specialist environmental consulting company providing holistic environmental management services, including environmental impact assessments and planning to ensure compliance and evaluate the risk of development; and the development and implementation of environmental management tools. Savannah Environmental benefits from the pooled resources, diverse skills and experience in the environmental field held by its team.

The Savannah Environmental team have considerable experience in environmental impact assessments and environmental management, and have been actively involved in undertaking environmental studies, for a wide variety of projects throughout South Africa, including those associated with electricity generation.

The EAPs from Savannah Environmental who are responsible for this project are:

» Karen Jodas - a registered Professional Natural Scientist and holds a Master of Science degree. She has 17 years of experience consulting in the environmental field. Her key focus is on strategic environmental assessment and advice; management and co-ordination of environmental projects, which includes integration of environmental studies and environmental processes into larger engineering-based projects and ensuring compliance to legislation and guidelines; compliance reporting; the identification of environmental management solutions and mitigation/risk minimising measures; and strategy and guideline development. She is currently responsible for the project management of EIAs for several renewable energy projects across the country.

» Ravisha Ajodhapersadh– the principle author of this report holds an Honours Bachelor of Science degree in Environmental Management and has 6 years of experience in environmental management. She is currently the responsible EAP for several renewable energy projects across the country.

In order to adequately identify and assess potential environmental impacts associated with the proposed project, Savannah Environmental appointed the following specialist sub-consultants to conduct specialist impact assessments:

» Ecology – David Hoare of David Hoare Consulting cc
» Soils, land-use and agricultural potential – Johan Van Der Waals of TerraSoil Science
» Heritage resources – Celeste Booth of the Albany Museum
» Noise – Morne De Jager of MENCO (M2 Environmental Connections cc)
» Visual – Lourens Du Plessis of MetroGIS (Pty) Ltd
» Social – Tony Barbour
» Palaeontology - Lloyd Rossouw
» Pre-construction bird monitoring programme and assessment report - the Endangered Wildlife Trust (EWT)
» Pre-construction bat monitoring programme and assessment report – Werner Marias of Animalia cc

Refer to **Appendix A** for the curricula vitae for Savannah Environmental and the specialist sub-consultants team.

African Clean Energy Developments (Pty) Ltd (ACED) under three special purpose vehicle's (SPV's) is proposing to establish a commercial wind energy facility and associated infrastructure on a site located within the Karoo Hoogland Local Municipality. The site is located within the Karoo Hoogland Local Municipality (approximately 30 km south of Sutherland in the Northern Cape Province). A larger site has been identified and has been identified for consideration within an Environmental Impact Assessment (EIA). Up to 207 wind turbines were proposed to be constructed over an area of approximately 340 km^2 in extent. This has subsequently been reduced to 170 turbines in response to specialist recommendations and is described in the in the conclusions chapters for each phase and this revised layout is supported by letters provided by the EIA specialists. Associated infrastructure proposed includes substation(s), access roads and power line(s). The larger project development area is proposed to be developed in a three-phased approach. As each phase of the project will be constructed and operated by a separate Special Purpose Vehicle, separate Environmental Authorisations will be required to be obtained. As such, each phase of this project has been registered with the National DEA under following project names and application reference numbers:

» Phase 1: Proposed Karusa Wind Farm (DEA Ref. No: 12/12/20/2370/1)
» Phase 2: Proposed Soetwater Wind Farm (DEA Ref. No: 12/12/20/2370/2)
» Phase 3: Proposed Great Karoo Wind Farm (DEA Ref. No: 12/12/20/2370/3)

The three separate phases (including the wind turbine layouts) of the wind energy facility (considered as individual projects) are shown in **Figure 2.1. Appendix Q** provides more detailed facility layout maps. The total capacity of the three phases of the wind energy facility will be up to 450 MW and will comprise of the following infrastructure:

» Wind turbines (between 2 and 3.5 MW in capacity) and associated foundations
» Cabling between the turbines, to be laid underground where practical[6].
» Internal access roads to each turbine.
» One power line for connection of each phase and a power line from the on-site substation to Komsberg Substation (i.e. a total of four power lines across the extent of the facility).

[6] Where underground cabling is not practical or environmentally sensible (e.g. in rocky area where blasting would be required), cabling would be above ground, suspended between ~8m high timber poles at ~60m centres.

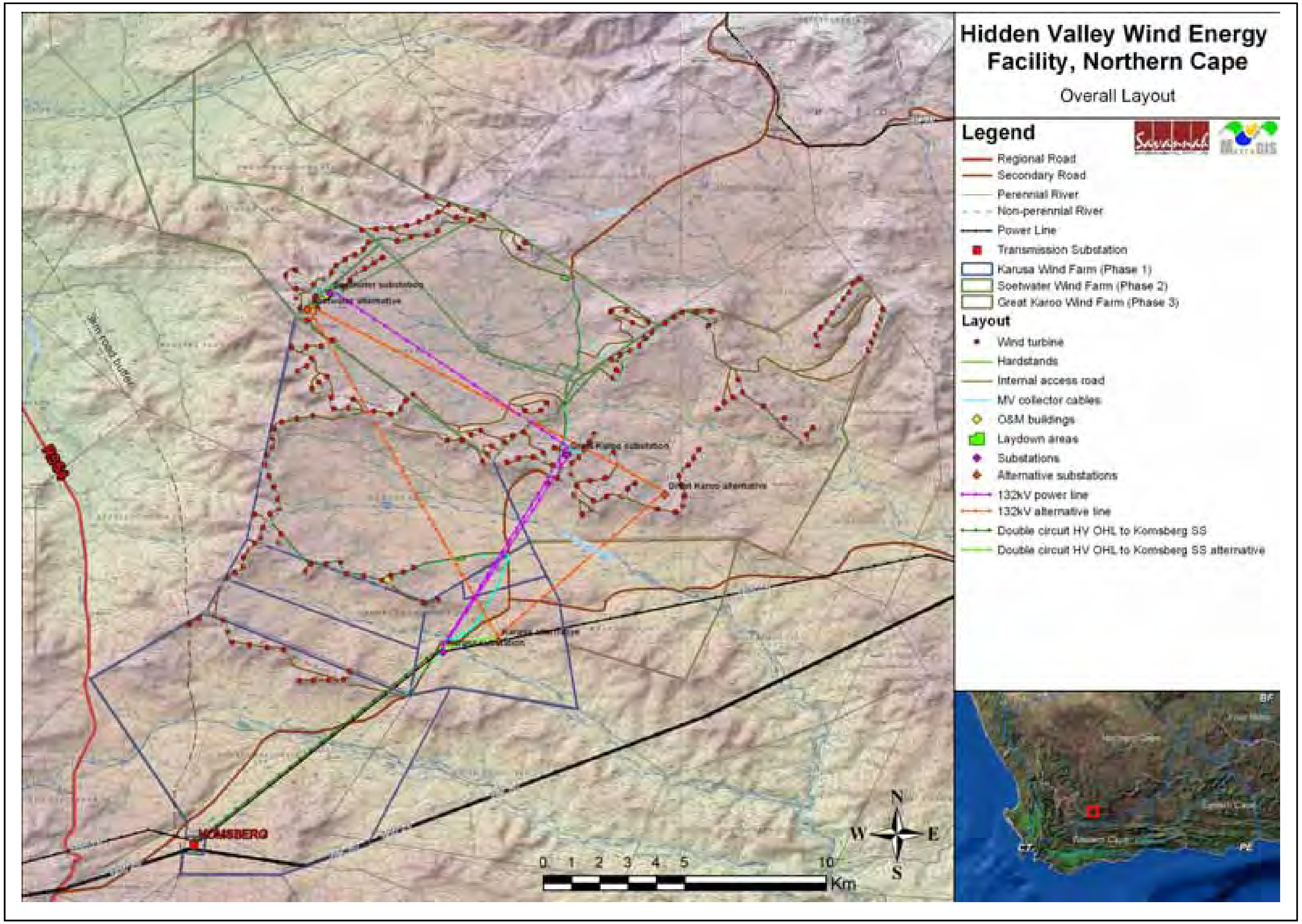

Figure 2.1: Map showing the three phases of the project and original wind turbine layout (207 turbines)

- One on-site substation (i.e. a total of three substations across the extent of the facility) to facilitate the connection of each phase of the wind energy facility and the Eskom grid at Komsberg Substation.
- Workshop area / office for control, maintenance and storage

2.1. Need and desirability of the proposed project

2.1.1 Renewable Energy Development Zones (REDZ)

The DEA in discussion with the DoE has been mandated by MinMec to undertake a Strategic Environmental Assessment (SEA). The DEA has subsequently appointed CSIR to manage wind and solar PV SEA processes. The SEAs are being undertaken in order to identify geographical areas most suitable for the rollout of wind and solar PV energy projects and the supporting electricity grid network. The CSIR has released a map with initial identification of geographical areas best suited for the roll-out of wind and solar photovoltaic (PV) energy projects in South Africa. These results form part of the strategic environmental assessment (SEA) that the CSIR is conducting for wind and solar energy, on behalf of the national Department of Environmental Affairs (DEA). The aim of the assessment is to designate renewable energy development zones (REDZs) within which such development will be incentivised and streamlined. The proposed Hidden Valley Wind Energy facility site falls within the Komsberg Wind Priority Area identified as a geographical area suitable for the rollout of the development of wind energy projects within the Western Cape and Northern Cape Provinces.

2.1.2 Financial Viability and Community Needs

In terms of the energy yield predicted for the facility calculated from more than 12 months monitored wind data, the developer considers the Hidden Valley Wind Energy facility to be financially viable. The "need and desirability" of the local community as reflected in an IDP for the area, is also considered in the EIA. In the South African context, developmental needs (community needs) are often determined through the above planning measures (IDP, SDF and EMF). The wind projects can contribute indirectly to the two Local Municipality's Integrated Development Plans (IDPs). In terms of the needs on the local community, the IDPs identified the need for development, social services, education and employment opportunities in this area. The Hidden Valley Wind Energy facility would contribute positively to these community needs. The project will create employment and business opportunities, as well as the opportunity for skills development for the local community. The project will result in benefits to the local community, in accordance with the localisation requirements of the REIPPP Programme. In addition, indirect benefits and spend in the local area will benefit the local community.

The development of the project would benefit the local/regional/national community by developing a renewable energy project. Surrounding communities would also benefit from the development through job creation and spin-offs. In addition, according to Department of Energy (DoE) bidding requirements the developer must plan for a percentage of the profit per annum from the wind energy facility to go back into the community through a social beneficiation scheme. Therefore there is a potential for creation of employment and business opportunities, and the opportunity for skills development of for the local community.

2.1.3 The Need for the Wind Energy Facility

The need for harnessing renewable energy resources (such as wind energy for electricity generation) is linked to increasing pressure on countries to increase their share of renewable energy generation due to concerns such as exploitation of non-renewable resources and the rising cost of fossil fuels. In order to meet the long-term goal of a sustainable renewable energy industry, a target of 17.8 GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010 and incorporated in the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme initiated by the DoE. This programme has been designed so as to contribute towards a target of 3725 MW to be generated from renewable energy sources, required to ensure the continued uninterrupted supply of electricity, towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa. The energy procured through this programme will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This 17,8GW of power from renewable energy amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, ACED proposes the establishment of the Hidden Valley Wind Energy facility to add new capacity to the national electricity grid.

2.1.4 The Desirability for the Wind Energy Facility

The use of wind power for electricity generation is essentially a non-consumptive use of a natural resource. A wind energy facility also qualifies as a Clean

Development Mechanism (CDM) project (i.e. a financial mechanism developed to encourage the development of renewable technologies) as it meets all international requirements in this regard. The proposed Karusa, Soetwater and Great Karoo Wind Energy Facility sites have been identified by ACED as highly desirable sites for wind energy based on extensive pre-feasibility analyses over several years of significant areas within the Western Cape, Northern Cape and Eastern Cape of South Africa. The proposed site was selected for the development of a wind energy facility based on its predicted wind climate (high wind speeds), suitable proximity in relation to the existing electricity grid, and minimum technical constraints from a construction and technical point of view. ACED considers this area, and specifically the three project development sites to be highly preferred for wind energy facility development. Wind monitoring has been undertaken using two 20m and two 80m wind monitoring masts in order to confirm the wind resource on the site, and ultimately inform the layout of the facility well as the turbine selection process. The sites display characteristics which, in the opinion of ACED's experienced wind development team, make the three phases of the development a preferred site for a wind energy facility:

» Together, the sites cover an area of ~340 km^2 which will allow for a significant installed capacity in one location. The area would form part of the identified node for wind energy in the Sutherland area (the Komsberg Wind Focus Area as identified by DEA).
» There are currently two 400 kV power lines that traverse the site and provide potential direct grid connection opportunities.
» The Komsberg Substation is adjacent to the Karusa Wind Farm site and the electricity from the project will be evacuated directly into this substation.
» Generation of electricity on the proposed site will significantly reduce transmission losses experienced by Eskom in the transmission of electricity from Gauteng and Mpumalanga to the coastal provinces.
» Construction and operation of the facilities would permit the continuation of present farming activities (cattle and sheep farming) and as such so it would not be considered a loss of agricultural land.

2.1.5 *How the principles of environmental management as set out in section 2 of NEMA have been taken into account in the planning for the proposed project*

The principles of NEMA have been considered in this assessment through compliance with the requirements of the relevant legislation in undertaking the assessment of potential impacts, as well as through the implementation of the principle of sustainable development where appropriate mitigation measures have been recommended for impacts which cannot be avoided. In addition, the successful implementation and appropriate management of this proposed project will aid in achieving the principles of minimisation of pollution and environmental degradation.

The EIA process has been undertaken in a transparent manner and all effort has been made to involve interested and affected parties, stakeholders and relevant Organs of State such that an informed decision regarding the project can be made by the Regulating Authority.

The general objectives of Integrated Environmental Management have been taken into account for this EIA report by means of identifying, predicting and evaluating the actual and potential impacts on the environment, socio-economic conditions and cultural heritage component. The risks, consequences, alternatives as well as options for mitigation of activities have also been considered with a view to minimise negative impacts, maximise benefits, and promote compliance with the principles of environmental management.

2.2. Technology Alternatives

Following significant consideration of technology alternatives based on site characteristics it was determined by the developer that the site would only be suitable for a wind energy facility, and is not suitable for the installation of other renewable energy technologies. Through the project development process, ACED will be considering various wind turbine designs and layouts in order to maximise the capacity of each phase the development site. The turbines being considered for use at this wind energy facility could be between 2 MW and 3.5 MW in capacity. The turbines will have a hub height of up to 100m, and a rotor diameter of 120m (i.e. each blade up to 65m in length). The technology provider has not yet been confirmed, and will only be decided after further wind analysis as well as a tender process.

2.3. Site-specific or Layout Design Alternatives

A wind turbine layout has been undertaken to effectively 'design' the wind energy facility (for each development phase). Through the process of determining constraining factors and environmentally sensitive areas during the scoping phase, the layout of the wind turbines and infrastructure has been developed by ACED (as shown in **Figure 2.1**.) This layout allows for adjustment to avoid site-specific environmental constraints, where necessary. The overall aim of the layout is to maximise electricity production through exposure to the wind resource, while minimising infrastructure, operation and maintenance costs, and social and environmental impacts. This layout detail has informed the specialist impact assessments in this EIA phase. The planning process also included the positioning of other ancillary infrastructure, including, the power line and internal substation sites.

Planning and design for the transmission of the power generated at the wind energy facility is being undertaken. This has been informed through understanding the local power requirements and the stability of the local electricity network. The grid connection for each phase is as follows:

» Phase 1 (Karusa): A new on-site substation complex (up to 400 kV in capacity) will be located adjacent to the existing Droerivier - Komsberg 2 400kV power line which traverses the site to allow for a direct connection to the Eskom grid. Two alternative substation locations are proposed. The location of the substation will allow for direct connection into the existing Droerivier - Komsberg 2 400kV power line (a loop in and loop out configuration), or through a power line connection from the on-site substation to the Eskom Komsberg Substation.
» Phase 2 (Soetwater): A new 132 kV substation is proposed within this phase. The electricity from the 132 kV substation will be transmitted via a 132 kV power line to the on-site substation located on the Phase 1 site for connection to the Eskom grid. Two alternative substation locations and power lines are proposed within this phase.
» Phase 3 (Great Karoo): A new 132 kV substation is proposed within this phase. The electricity from the 132 kV substation will be transmitted via a 132 kV power line to the on-site substation located on the Phase 1 site for connection to the Eskom grid. Two alternative substation locations and power lines are proposed within this phase.

Alternative routes/corridors for the power lines (one for each project development phase and a power line from the on-site substation to Komsberg Substation) have as been assessed in this EIA report. A description of the layout / design alternatives is provided below. The substation locations and power line routing for all three phases are shown in Figure 2.2.

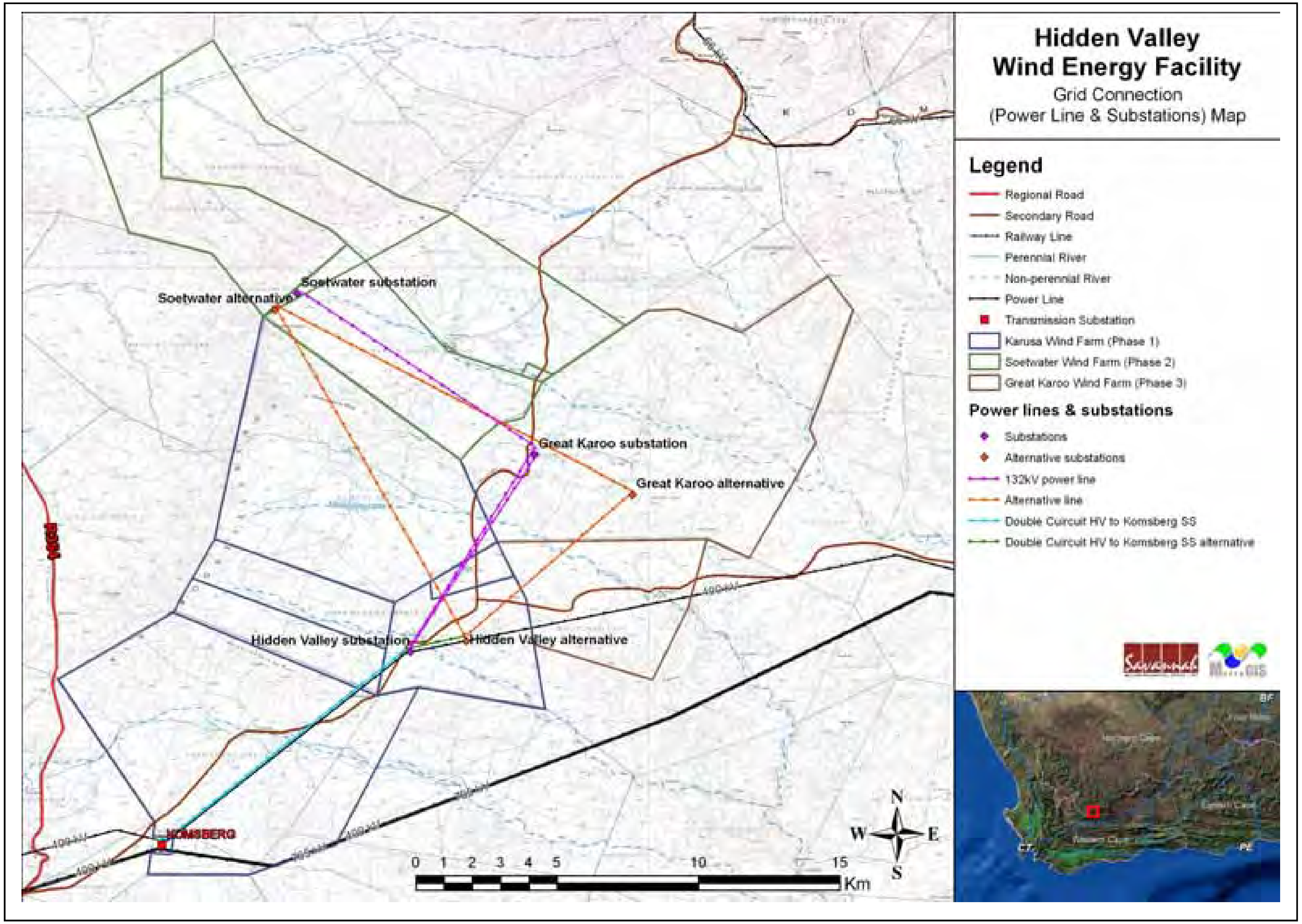

Figure 2.2: Map showing the alternative substation locations and power line alignments for Phase 1 – Phase 3 of the Hidden Valley wind energy facility

2.3.1 Grid Connection – Phase 1 (Karusa Wind Farm)

Two options for the location of the up to 400 kV substation are proposed:

» *Karusa Substation Option 1:* the substation is located on Farm Standvastigheid, directly adjacent to the existing Droerivier-Komsberg 2 400 kV power line (which connects to Komsberg Substation).
» *Karusa Substation Option 2:* the substation is located on Farm Standvastigheid, directly adjacent to the existing Droerivier-Komsberg 2 400 kV power line (which connects to Komsberg Substation).
» *A double circuit high voltage overhead line is required to connect the project to the Eskom Komsberg substation.*

A new on-site substation complex (up to 400 kV in capacity) will be located adjacent to the existing Droerivier - Komsberg 2 400kV power line which traverses the site to allow for a connection to the Eskom grid. The location of the substation will allow for connection into the existing Droerivier - Komsberg 2 400kV power line (a loop in and loop out configuration), or through a power line connection from the on-site substation to the Eskom Komsberg Substation. The red line on Figure 2.3 indicates the alignment of the existing Eskom power lines in this area as well as the existing Komsberg Substation. Substation Option 1 with the high voltage double circuit overhead line connecting the Project into the Eskom Komsberg substation is technically preferred.

2.3.2 Grid Connection – Phase 2 (Soetwater Wind Farm)

Two alternative 132 kV substation locations and associated power lines are proposed with the Soetwater Wind Farm ultimately connecting to the Eskom Komsberg substation via a double circuit high voltage overhead line.

» Substation Option 1 is located on Farm Orangefontien.
» Power line Option 1 is 17 km in length and connects Substation Option 1 with the preferred up to 400 kV substation (Substation Option 1 located on the Karusa site). The power line is proposed to cross the Farms 206, 209 and 207 to connect via the up to 400 kV substation located on the Karusa site and through a double circuit high voltage line into the Eskom Komsberg.
» Substation Option 2 and Power line Option 2 is 13 km in length and connects Substation Option 2 with the up to 400 kV substation (Substation Option 2 located on the Karusa site). The power line is proposed to cross the Farms 185,

and 202 to connect via the up to 400 kV substation located on Farm 209 on the Karusa site and through a double circuit high voltage line into the Eskom Komsberg.

» The red lines on the map indicate existing power lines. Option1 connecting through a double circuit high voltage line into the Eskom Komsberg is technically preferred.

The Soetwater power lines connect via Phase 1 (Karusa) power lines and into Komsberg substation.

2.3.2 Grid Connection – Phase 3 (Great Karoo Wind Farm)

Two alternative 132 kV substation locations and associated power lines are proposed with the Great Karoo Wind Farm ultimately connecting to the Eskom Komsberg substation via a double circuit high voltage overhead line.

» Substation and power line Option 1 is 7 km in length and runs through from Farm 206 and 209 to the 400 kV substation (located on the Karusa site) and connects to the Eskom Komsberg substation via a double circuit high voltage overhead line.
» Option 2 is 8 km in length and runs through Farm 206, 207 and 209 until it reaches the 400 kV substation on Farm 209 and connects to the Eskom Komsberg substation via a double circuit high voltage overhead line.
» The red lines on the map indicate existing power lines.
» Option 1 is technically preferred.

The Great Karoo power lines connect via Phase 1 (Karusa) power lines and into Komsberg substation.

2.4. The ‘do-nothing’ Alternative

The ‘do-nothing’ alternative is the option of not constructing the wind energy facility on the proposed site. Two main reasons why the do-nothing alternative is not preferred in relation to this wind energy facility project are discussed below, namely:
» The current land-use regime of the site; and
» The need to diversify the energy mix is South Africa.

The agricultural potential of the entire study site (i.e. including all three development phases) is very low and limited to extensive grazing due to the low rainfall and distinct soil constraints. The soil constraints are centred around the fact that the site is hilly with steep slopes dominating the bulk of the landscape. Under these conditions soils are shallow and rocky and agriculture is, therefore, limited to flat areas in localised floodplains. There is only little potential to increase the agricultural potential in the form of irrigation development as the irrigable soils are very limited in their distribution and extent. Water availability, however, is limited to groundwater (scarce and of variable quality) and occasional surface water contained in dams as a result rainfall events. Much of the study area consists of rock and shallow soils (Glenrosa and Mispah) of low potential. The shallower soils are suited for grazing at best. The grazing capacity of the area is moderately low. The long-term annual average rainfall in the area means that there is a low potential for arable agriculture on the site and study area. Therefore, the "do nothing" alternative would leave current land-use and livestock grazing, with losing out the opportunity to generate renewable energy from the wind and at the same time continue current livestock grazing on areas that outside of the proposed wind energy facility infrastructure. Therefore, from a land-use perspective, the do nothing alternative is not preferred.

The electricity demand in South Africa is placing increasing pressure on the country's existing power generation capacity. There is, therefore, a need for additional electricity generation options to be developed throughout the country. The decision to expand South Africa's electricity generation capacity, and the mix of generation technologies is based on **national policy** and informed by on-going strategic planning undertaken by the national Department of Energy (DoE), the National Energy Regulator of South Africa (NERSA) and Eskom Holdings Limited (as the primary electricity supplier in South Africa). The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind and that renewable applications are in fact the least-cost energy service in many cases - and more so when social and environmental costs are taken into account.

The generation of electricity from renewable energy in South Africa offers a number of socio-economic and environmental benefits. These benefits are explored in further by NERSA (March 2009), and include:

» **Increased energy security:** The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of supplementing the power available. In addition, given that renewables can often be deployed in a decentralised manner close to consumers, they offer the opportunity for improving grid strength and supply quality, while reducing expensive transmission and distribution losses.
» **Resource saving:** Conventional coal fired plants are major consumers of water during their requisite cooling processes. It is estimated that the achievement of

the targets in the Renewable Energy White Paper will result in water savings of approximately 16.5 million kilolitres, where compared with wet cooled conventional power stations. This translates into revenue saving of R26.6 million. As an already water stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly as the detrimental effects of climate change on water availability are experienced in the future.

» **Exploitation of our significant renewable energy resource:** At present, valuable national resources (including biomass by-products, solar insulation and wind) remain largely unexploited. The use of these energy flows will strengthen energy security through the development of a diverse energy portfolio.
» **Pollution reduction:** The releases of by-products of fossil fuel burning for electricity generation have a particularly hazardous impact on human health, and contribute to ecosystem degradation.
» **Climate friendly development:** The uptake of renewable energy offers the opportunity to address energy needs in an environmentally responsible manner, contributing to the mitigation of climate change through the reduction of greenhouse gas emissions. South Africa as a nation is estimated to be responsible for 1% of global GHG emissions and is currently ranked 9th worldwide in terms of per capita CO_2 emissions.
» **Support for international agreements and enhanced status within the international community:** The effective deployment of renewable energy provides a tangible means for South Africa to demonstrate its commitment to its international agreements under the Kyoto Protocol, and for cementing its status as a leading player within the international community.
» **Employment creation:** The sale, development, installation, maintenance and management of renewable energy facilities has significant potential for job creation in South Africa.
» **Acceptability to society:** Renewable energy offers a number of tangible benefits to society including reduced pollution concerns, improved human and ecosystem health and climate friendly development.
» **Support to a new industry sector:** The development of renewable energy offers an opportunity to establish a new industry within the South African economy.
» **Protecting the natural foundations of life for future generations:** Actions to reduce our disproportionate carbon footprint can play an important part in ensuring our role in preventing dangerous anthropogenic climate change; thereby securing the natural foundations of life for generations to come.

At present, South Africa is some way off from exploiting the diverse gains from renewable energy and from achieving a considerable market share in the renewable energy industry. South Africa's electricity supply remains heavily dominated by coal-based power generation, with the country's significant renewable energy potential largely untapped to date.

Within a policy framework, the development of renewable energy in South Africa is supported by the White Paper on Renewable Energy (November 2003), which has set a target of 10 000 GWh renewable energy contributions to final energy consumption. Furthermore the IRP 2010 states that 42% share of all new power generation should be derived from renewable energy forms, as targeted by the Department of Energy (DoE) (Integrated Resource Plan 2010 – 2030). The target is to be achieved primarily through the development of wind, biomass, solar and small-scale hydro. DME's macroeconomic study on renewable energy, developed under the now completed Capacity Building in Energy Efficiency and Renewable Energy (CaBEERE) project, has established that the achievement of this target would provide a number of economic benefits, including increased government revenue amounting to R299 million, increased GDP of up to R1 billion per year and the creation of an estimated 20 500 new jobs. In addition, the development of renewable energy beyond the 10 000 GWh target holds further employment benefits and would maximise the number of jobs created per TWh (NERSA, March 2009).

Through research, the viability of a wind energy facility south of Sutherland has been established, and ACED proposes that up to 207 turbines for the entire facility (i.e. all three phases of development), depending on the turbine capacity, used can be established as part of the facility. The purpose of the three phases of the wind energy facility is to add new capacity for generation of renewable energy to the national electricity supply, which is short of generation capacity to meet current and expected demand, and to aid in achieving the goal of a 30% share of all new power generation being derived from independent power producers (IPPs), as targeted by the Department of Energy (DoE). The 'do nothing' alternative will not assist the South African government in meeting increasing power supply demand or in reaching the set targets for renewable energy. In addition, the Northern Cape's power supply will be deprived of an opportunity to benefit from the additional generated power being evacuated directly into the Provinces' grids.

The 'do nothing' alternative is not a preferred alternative, as if the wind energy facility (all three phases) is not developed the following positive impacts will not be realised:

» Job creation from the construction and operational phases.
» Economic benefit to participating landowners due to the revenue that will be gained from leasing the land to the developer.
» Utilisation of clean, renewable energy in an area where it is optimally available.

Wind power is the conversion of wind energy into a useful form, such as electricity, using wind turbines. The use of wind for electricity generation is a non-consumptive use of a natural resource, and produces an insignificant quantity of greenhouse gases in its lifecycle. Wind power consumes no fuel for continuing operation, and has no emissions directly related to electricity production.

Wind energy is one of the fastest growing electricity generating technologies and features in energy plans worldwide. Operation does not produce carbon dioxide, sulphur dioxide, mercury, particulates, or any other type of air pollution, as do fossil fuel power sources.

Environmental pollution and the emission of CO_2 from the combustion of fossil fuels constitute a threat to the environment. The use of fossil fuels is reportedly responsible for ~70% of greenhouse gas emissions worldwide. The climate change challenge needs to include a shift in the way that energy is generated and consumed. Worldwide, many solutions and approaches are being developed to reduce emissions. However, it is important to acknowledge that the more cost effective solution in the short-term is not necessarily the least expensive long-term solution. This holds true not only for direct project cost, but also indirect project cost such as impacts on the environment. Renewable energy is considered a ‘clean source of energy’ with the potential to contribute greatly to a more ecologically, socially and economically sustainable future. The challenge now is ensuring wind energy projects are able to meet all economic, social and environmental sustainability criteria.

Wind energy has the attractive attribute that the fuel is free. The economics of a wind energy project crucially depend on the wind resource at the site. Detailed and reliable information about the speed, strength, direction, and frequency of the wind resource is vital when considering the installation of a wind energy facility, as the wind resource is a critical factor to the success of the installation.

Wind speed is the rate at which air flows past a point above the earth's surface. Average annual wind speed is a critical siting criterion, since this determines the cost of generating electricity. With a doubling of average wind speed, the power in the wind increases by a factor of 8, so even small changes in wind speed can produce large changes in the economic performance of a wind energy facility (for example, an increase of average wind speed from 22 km/hr to 36 km/hr (6 m/s to 10 m/s) increases the amount of energy produced by over 130%). Wind turbines can start generating at wind speeds of between 10 km/hr to 15 km/hr (~3 m/s to 4 m/s), with nominal wind speeds required for full power operation varying between

~45 km/hr and 60 km/hr (~12.5 m/s to 17 m/s). Wind speed can be highly variable and is also affected by a number of factors, including surface roughness of the terrain.

Wind power is a measure of the energy available in the wind.

Wind direction at a site is important to understand as it influences the turbulence over the site, and therefore the potential energy output. However, wind turbines can extract energy from any wind direction as the nacelle automatically turns to face the blades into the predominant wind direction at any point in time.

South Africa in general can be considered as having a moderate wind resource as compared to Northern Europe (Scandinavia), Great Britain and Ireland, New Zealand and Tasmania. Typical annual wind speeds range from 15 km/hr to 25 km/hr (4 m/s to 7 m/s) around South Africa's southern, eastern and western coastlines (with more wind typically along the coastline).

The wind speed measurements taken at a particular site are affected by the local topography (extending to a few tens of kilometres from the mast) or surface roughness. This is why local on-site monitored wind speed data is so important for detailed wind energy facility design. The effect of height variation/relief in the terrain is seen as a speeding-up/slowing-down of the wind due to the topography. Elevation in the topography exerts a profound influence on the flow of air, and results in turbulence within the air stream, and this also has to be taken into account in the placement of turbines.

A wind resource measurement and analysis programme is underway to provide measured data and a prediction of the facility's expected energy production over its lifetime. The design (and micro-siting) of a wind energy facility is sensitive to the predominant wind directions and wind speeds for the site. Although modern wind turbines are able to yaw to the direction of the wind, the micro-siting must consider the wind direction and strength of the wind in the optimal positioning of the turbines.

Wind turbines typically need to be spaced approximately 2 to 3xD apart, and 5 to 7xD where a turbine is behind another (D = the diameter of the rotor blades). This is required to minimise the induced wake effect the turbines might have on each other. Once a viable footprint for the establishment of the wind energy facility has been determined (through the consideration of both technical and environmental criteria), the micro-siting of the turbines on the site will be determined using industry standard software systems, which will automatically consider the spacing requirements.

3.1 How do wind turbines function

Wind turbines, like windmills, are mounted on a tower to capture the most energy. The kinetic energy of wind is used to turn a wind turbine to generate electricity. At 30 m or more aboveground, they can take advantage of the faster and less turbulent wind. Turbines catch the wind's energy with their propeller-like blades. Usually, two or three blades are mounted on a shaft to form a ***rotor***. Generally a wind turbine consists of **three rotor blades** and a **nacelle** mounted at the top of a tapered **tower**. The mechanical power generated by the rotation of the blades is transmitted to the generator within the nacelle via a gearbox and drive train.

Turbines are able to operate at varying speeds. The amount of energy a turbine can harness depends on both the wind velocity and the length of the rotor blades. It is anticipated that the turbines utilised for the proposed wind energy facility will have a hub height of between 80 m and 120 m, and a rotor diameter of up to 120m (i.e. each blade up to maximum 65 m in length). These turbines would have a generating capacity of between 2 MW and 3.5 MW (in optimal wind conditions). Wind turbines can start generating at wind speed of between 10 km/hr to 15 km/hr (~3 m/s to 4 m/s), with nominal wind speeds required for full power operation varying between ~45 km/hr and 60 km/hr (12.5 m/s and 17 m/s).

The capacity of the wind energy facility will depend on the wind turbine chosen by ACED (turbine capacity and model that will be deemed most suitable for the site) but will be limited to a maximum of 140MW (measured at the point of connection to the Eskom grid) per phase. Turbines of between 2 MW and 3.5 MW in capacity are being considered for the site. At this stage, 207 turbines are estimated for all the phases of the site and will also depend on the turbine capacity actually used.

Other infrastructure associated with the facility includes internal service roads, an access road and power lines. The construction phase of each wind energy facility is dependent on the number of turbines erected and is estimated at one week per turbine, or in total approximately 48 months (including all infrastructure). The lifespan of each facility is between 20 to 30 years.

3.1.1. Main Components of a Wind Turbine

The turbine consists of the following major components:

» The rotor
» The nacelle
» The tower
» The foundation unit

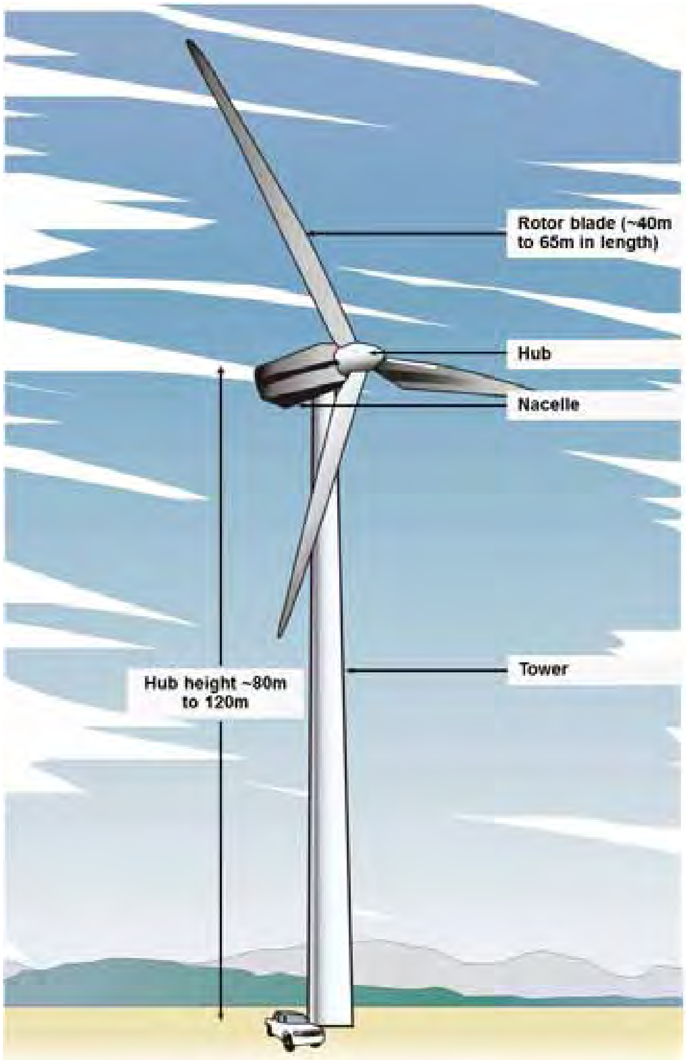

Figure 3.1: Illustration of the main components of a wind turbine

The Rotor

The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor comprises of three rotor blades (the approximate rotor diameter is in the range of up to 120m, and the length of blade is between 40m – 65m long). The rotor blades use the latest advances in aeronautical engineering materials science to maximise efficiency. The greater the number of turns of the rotor the more electricity is produced. The rotor converts the energy in the wind into rotational energy to turn the generator. The rotor has three blades that rotate at a constant speed of about 15 to 28 revolutions per minute (rpm). The speed of rotation of the blades is controlled by turning the blades to face into the wind ('yaw control'), and changing the angle of the blades ('pitch control') to make the most use of the available wind.

The rotor blades function in a similar way to the wing of an aircraft, utilising the principles of **lift** (Bernoulli). When air flows past the blade, a wind speed and pressure differential is created between the upper and lower blade surfaces. The pressure at the lower surface is greater and thus acts to "lift" the blade. When blades are attached to a central axis, like a wind turbine rotor, the lift is translated into rotational motion. Lift-powered wind turbines are well suited for electricity generation.

The rotation of the rotor blades produces a characteristic 'swishing' sound as the blades pass in front of the tower roughly once a second. The other moving parts, the gearbox and generator, cannot be heard unless the observer is physically inside the turbine tower.

The nacelle

The nacelle contains the generator, control equipment, gearbox and anemometer for monitoring the wind speed and direction (as shown in **Figure 3.2**).

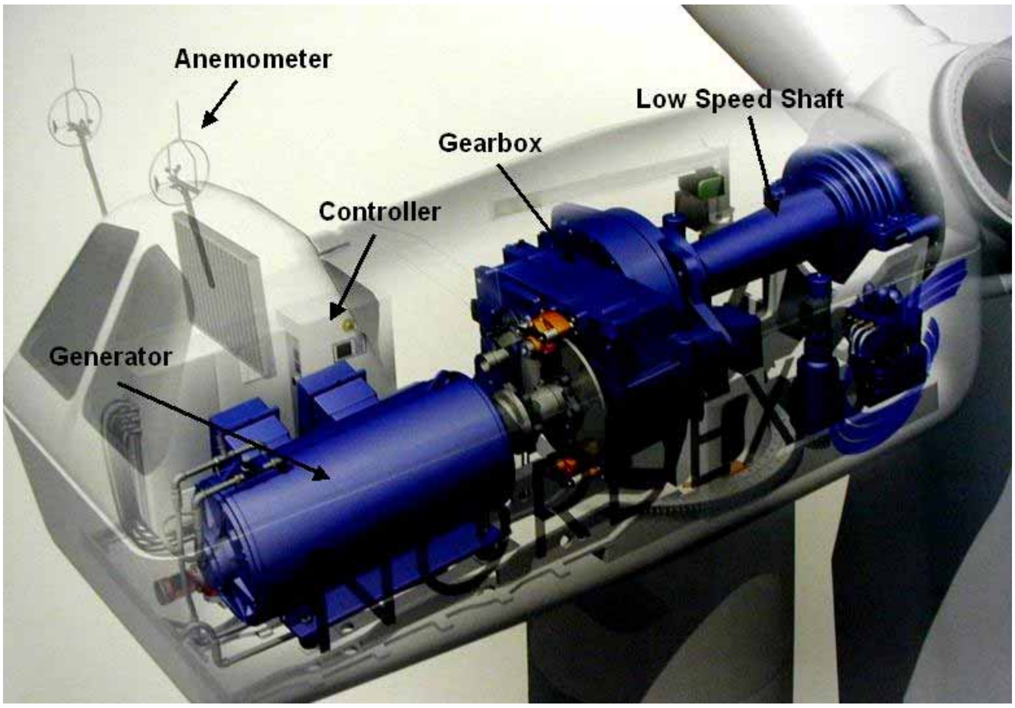

Figure 3.2: Detailed structure of a nacelle of a horizontal axis turbine

The **generator** is what converts the turning motion of a wind turbine's blades into electricity. Inside this component, coils of wire are rotated in a magnetic field to produce electricity. The generator's rating, or size, is partly dependent on the length of the wind turbine's blades because more energy is captured by longer blades.

The tower

The tower is a hollow structure allowing access to the nacelle (between 80m and 120m in height). The height of the tower is a key factor in determining the amount of electricity a turbine can generate. Small transformers may occur outside each turbine tower, depending on what make and model of turbine is deemed most suitable for the site. Such a transformer would have its own foundation and housing around it. Alternatively, the transformer could be housed within the tower. The transformers convert the electricity to the correct voltage for transmission into the grid.

The tower on which a wind turbine is mounted is not just a support structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. The tower must be strong enough to support the wind turbine and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

3.1.2 Operating Characteristics of a Wind Turbine

A turbine is designed to operate continuously, unattended and with low maintenance for more than 20 years or >120 000 hours of operation. Once operating, a Wind Energy Facility can be monitored and controlled remotely, with a mobile team for maintenance, when required.

The **cut-in speed** is the minimum wind speed at which the wind turbine will generate usable power. This wind speed is typically between 10 and 15 km/hr (~3 m/s and 4 m/s).

At very high wind speeds, typically over 90 km/hr (25 m/s), the wind turbine will cease power generation and shut down. The wind speed at which shut down occurs is called the **cut-out speed**. Having a cut-out speed is a safety feature which protects the wind turbine from damage. Normal wind turbine operation usually resumes when the wind drops back to a safe level.

It is the flow of air over the blades and through the rotor area that makes a wind turbine function. The wind turbine extracts energy by slowing the wind down. The theoretical maximum amount of energy in the wind that can be collected by a wind turbine's rotor is approximately 59%. This value is known as the Betz Limit. If the blades extracted 100% of the wind’s energy, a wind turbine would not work because the air, having given up all its energy, would entirely stop. So, if a blade were 100% efficient then it would extract 59% of the energy as this is the maximum (due to Betz law). In practice, the collection efficiency of a rotor is not 100%. A more typical efficiency is 35% to 45%. A complete wind energy system incurs losses through friction etc. and modern systems end up converting between 20-25% of the energy in the air into electricity which equates to 34-42% of the maximum (due to Betz Law).

However, because the energy in the air is free, describing how efficiently the energy is converted is only useful for system improvement and monitoring purposes. A more useful measurement is the Capacity Factor which is also represented as a percentage. The Capacity Factor percentage is calculated from the actual MWh output of electricity from the entire wind farm over 1 year divided by the nameplate maximum theoretical output for the same period. It therefore also takes wind resource, wind variability and system availability (downtime, maintenance and breakdowns) into account. This figure will be predicted more accurately when more on-site wind data has been recorded.

Wind turbines can be used as stand-alone applications, or they can be connected to a utility power grid. For utility-scale sources of wind energy, a large number of wind turbines are usually built close together to form a **wind energy facility.**

3.2 Project Construction Phase

The steps which are typical of the construction phase of the project described below are relevant to all three phases of the development (i.e. the Karusa Wind Farm, Soetwater Wind Farm and Great Karoo Wind Farm). The length of the construction period of one phase of the wind energy facility is estimated at a minimum of 18 months. The lifespan of each of the three phases of the wind energy facility is approximated at 20 to 30 years. In order to construct the proposed wind energy facility and associated infrastructure, a series of activities will need to be undertaken. The construction process is discussed in more detail below.

3.3.1. Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to:

- Geotechnical survey to provide information regarding subsurface characteristics for founding conditions and road building. This process will be required to be undertaken by a qualified geotechnical engineer.
- Wind energy facility site survey and confirmation (and pegging) of the turbine micro-siting footprints, laydown areas and access road routes. This micro-siting exercise will be required to be undertaken in conjunction with qualified heritage and vegetation specialists.
- Survey of substation site. This will be required to be undertaken in conjunction with qualified vegetation specialist.
- Survey and profiling of power line servitude to determine specific tower locations. This profiling exercise will be required to be undertaken in conjunction with qualified heritage, vegetation and avifauna specialists.

3.3.2 Establishment of Access Roads to the Site

The site can be accessed via a gravel road which joins the R354 main road to Sutherland. Access/haul roads to the site as well as internal access roads within the site are required to be established. The internal access roads will be up to 8 m in width. As far as possible, existing access roads to the site would be utilised, and upgraded where required. Within the site itself, access will be required between the turbines for construction purposes (and later limited access for maintenance). The internal service road alignment will be informed by the final micro-siting/positioning of the wind turbines. These access roads will have to be constructed in advance of any components being delivered to site, and will remain in place after completion for future access, access for replacement of parts if necessary and decommissioning.

3.3.3. Undertake Site Preparation

Site preparation activities will include clearance of vegetation at the footprint of each turbine, the establishment of laydown areas, the establishment of internal access roads and excavations for foundations. These activities will require the stripping of topsoil, which will need to be stockpiled, backfilled and/or spread on site.

Site preparation will be undertaken in a systematic manner to reduce the risk of open ground to erosion. In addition, site preparation will include search and rescue of floral species of concern (where required), as well as identification and excavation of any sites of cultural/heritage value (where required).

3.3.4. Construct Foundation

Concrete or rock adaptor foundations will be constructed at each turbine location. For concrete foundations, foundation holes will be mechanically excavated to a depth of approximately 4 m, depending on the local geology. Concrete may to be brought to site as ready-mix or batched at an appropriate location on site.. The reinforced concrete foundation of up to 20m x 20m x 4m will be poured and will support a mounting ring. The foundation will then be left up to a week to cure. Where the bedrock is of a suitable strength and type, rock adaptor foundations can be used which are bolted into the rock. This requires much less excavation and reduced concrete usage.

3.3.5. Transport of Components and Equipment to Site

The wind turbine, including the tower, will be brought on site by the turbine supplier in sections on flatbed trucks. Turbine units which must be transported to site consist of: the tower (in segments), hub, nacelle, and three rotor blades. The individual components are defined as abnormal loads in terms of Road Traffic Act (Act No 29 of 1989)[7] by virtue of the dimensional limitations (abnormal length of the blades) and load limitations (i.e. the nacelle). In addition, components of various specialised construction and lifting equipment are required on site to erect the wind turbines and need to be transported to site. In addition to the specialised lifting equipment/cranes, the normal civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, welfare facilities, site offices etc.).

The components required for the establishment of the substation/s (including transformers) as well as the power line (including towers and cabling) will also be transported to site as required.

The dimensional requirements of the load during the construction phase (length/height) may require alterations to the existing road infrastructure (e.g. widening on corners), accommodation of street furniture (e.g. street lighting, traffic signals, telephone lines etc.) and protection of road-related structures (i.e. bridges, culverts, portal culverts, retaining walls etc.) as a result of abnormal loading.

The equipment will be transported to the site using appropriate National and Provincial roads, and the dedicated access/haul road to the site itself.

3.3.6. Establishment of Laydown Areas on Site

Laydown areas will need to be established at each turbine position for the storage and assembly of wind turbine components. The laydown area will need to accommodate the cranes required in tower/turbine assembly. Laydown and storage areas will be required to be established for the normal civil engineering construction equipment which will be required on site.

In addition a number of construction compound areas will need to be established around the site. These will be temporary structures for site offices, welfare facilities, storage and safe refuelling areas (200 m^2).

A large laydown area will be required at each position where the main lifting crane may be required to be assembled and/or disassembled. This area would be required to be compacted and levelled to accommodate the assembly crane, which would need to access the main lifting crane from all sides.

[7] A permit will be required for the transportation of these abnormal loads on public roads.

Figure 3.3: Photograph illustrating the laydown areas required during the erection of one of the turbines at the Klipheuwel demonstration facility (photo courtesy of Eskom)

3.3.7. Construct Turbine

A large lifting crane will be brought on site. It will lift the tower sections into place. The nacelle, which contains the gearbox, generator and yawing mechanism, will then be placed onto the top of the assembled tower. The next step will be to assemble (or partially assemble) the rotor (i.e. the blades of the turbine) on the ground, depending on the local conditions. It will then be lifted to the nacelle and bolted in place. Sometimes the third blade is connected after the rotor has been fixed on the nacelle. A small crane will likely be needed for the assembly of the rotor on the ground while a large crane will be needed to put it in place.

3.3.8 Construct Substation

Each of the three development phases will have an on-site substation (therefore a total of three substations for the project) to facilitate the connection between the wind energy facility and the grid at Eskom's Komsberg Substation which is located on the southern boundary of the Karusa site. Turbines will be connected to the on-site substation via underground cabling or overhead medium voltage cabling[8]. The position of the substations has been informed by the final micro-siting/positioning of the wind turbines. Each substation will be constructed with a high-voltage (HV) yard footprint of up to 40 000m^2.

The construction of the substations would require a survey of the site; site clearing and levelling and construction of access road/s to the substation sites (where required); construction of substation terrace and foundations; assembly, erection and installation of equipment (including transformers); connection of conductors to equipment; and rehabilitation of any disturbed areas and protection of erosion sensitive areas.

3.3.9 Establishment of Ancillary Infrastructure

A workshop, control building, administration building and guard house will be required to be constructed for each phase. A contractor's camp, temporary storage areas and a construction compound and service building(s) are also required for each phase. The establishment of these facilities/buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required.

3.3.10 Connection of Wind Turbines to the Substation

For each phase of the development, each wind turbine will be connected to the substation by medium voltage electrical cables (circa 33 kV). Where underground cabling is not practical or environmentally sensible (e.g. in rocky area where blasting would be required), cabling would be above ground, suspended between ~8m high timber poles at ~60m centres. The cables will be planned to follow the internal access roads, where possible.

3.3.11 Connect Substation/s to Power Grid

Each of the three development phases will include the construction of one new power line including a 12km double power line to the Eskom Komsberg Substation (i.e. a total of three power lines for the full extent of the three projects). Each of the three development phases will have an on-site substation to facilitate the connection between the wind energy facility and the Eskom grid (i.e. a total of 3 substations). Each substation will connect to the Eskom grid via the Karusa Wind Farm Substation and a high voltage double circuit power line to the Eskom

[8] Where underground cabling is not practical or environmentally sensible (e.g. in rocky area where blasting would be required), cabling would be above ground, suspended between ~8m high timber poles at ~60m centres.

Komsberg Substation. The double circuit line will require a servitude of approximately 36 m in width. Corridors for the power lines will be refined, surveyed and pegged prior to construction. The construction of the power line will involve clearing of a servitude and assembly and stringing of the power line.

The power line will be constructed utilising a monopole structure/tower with stand-off insulators and will be approximately 25 m in height. The power line will be a double circuit power line (i.e. two 132 kV circuits carried by a single tower structure) for the configuration at Karusa Wind Farm, and a double or single circuit for the Soetwater and Great Karoo Wind Farms, and will require a servitude of approximately 36 m in width.

3.3.12. Undertake Site Rehabilitation

As construction is completed in an area, and as all construction equipment is removed from the site, the site will be rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation. Due to the mobility of the sandy soils, and as rehabilitation and recovery of vegetation on the site will be slow, rehabilitation activities will (as far as possible) be carried out at each turbine location once construction of that particular turbine is completed. Appropriate rehabilitation measures are detailed in the draft Environmental Management Programme included in Appendices N, O and P (one EMPr for each phase).

3.2. Project Operation Phase

Figure 3.4 illustrates a conceptual diagram of a wind energy facility. The wind causes the wind turbine blades to rotate, and the kinetic energy of the wind is converted to mechanical energy. The energy is transported via cables to a central point/s i.e. the substation, where the voltage of the electricity is increased. The electricity is transferred via a power line to the nearest point of connection with Eskom's grid for wider distribution and use by consumers. It is important to note that the energy from a wind energy facility cannot be stored, and that it must be evacuated into the grid as it is produced.

Table 3.1 summarises the area to be occupied by the wind turbines and associated infrastructure during its operational life.

Infrastructure	Area to be occupied

Turbine concrete foundation	20 m x 20 m (for one wind turbine)
Internal roads (width)	8 m
Power line (servitude width)	32kV = 36m 400kV = 55m
One substation	40 000 m^2 each
Workshop / office area	2000m^2 each
Guardhouse	50m^2

Once operational, the wind energy facility will be monitored remotely. It is estimated that the operational phase of the project will provide employment for approximately 6 - 10 skilled staff members, who will be responsible for monitoring and maintenance when required. No permanent staff will be required on-site for any extended period of time.

Each turbine within the wind energy facility will be operational except under circumstances of mechanical breakdown, inclement weather conditions or maintenance activities. The wind turbine will be subject to periodic maintenance and inspection. Periodic oil changes will be required. Any waste products (e.g. oil) will be disposed of in accordance with relevant waste management legislation.

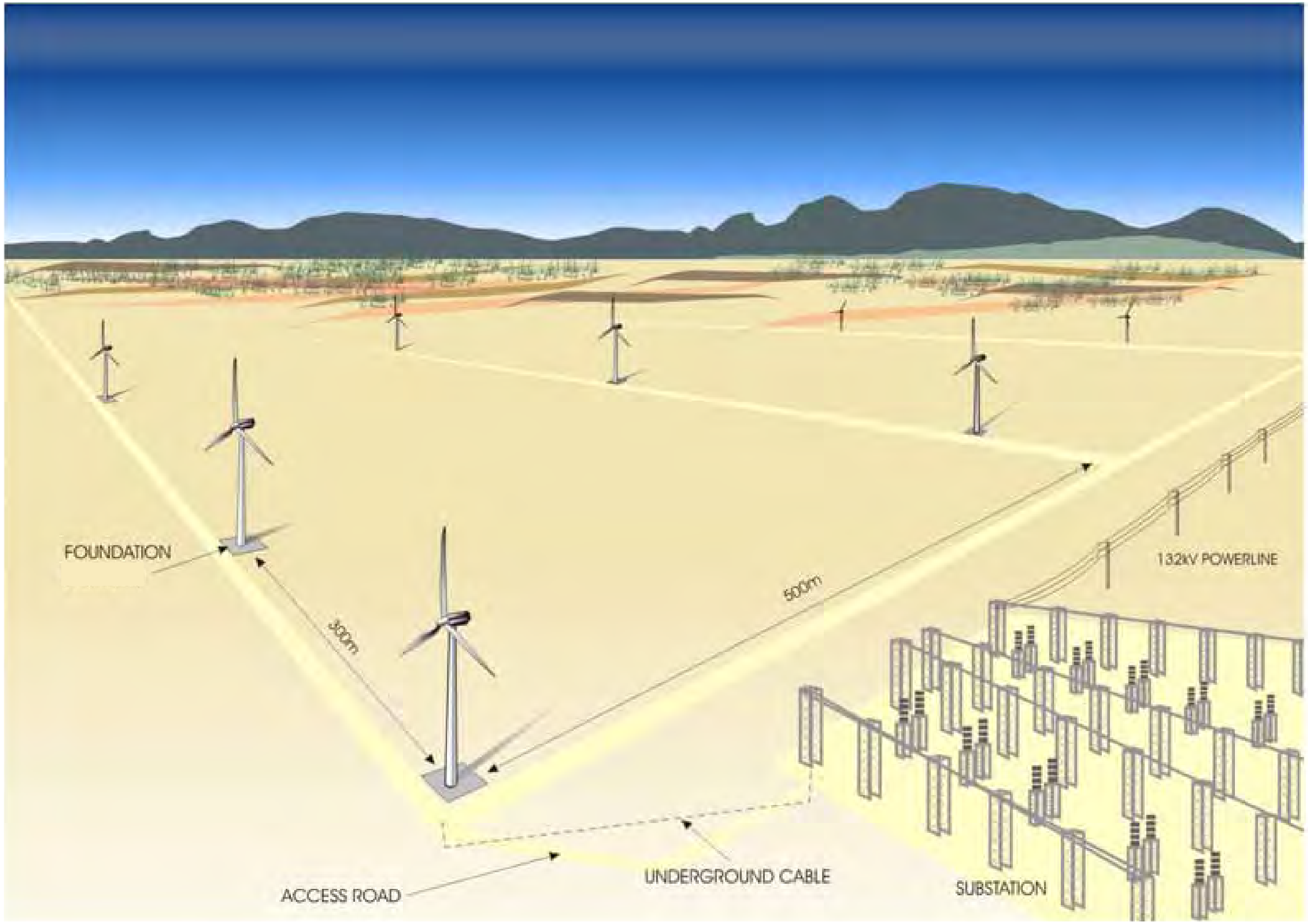

Figure 3.4: Artists impression of a portion of a wind energy facility, illustrating the various components and associated infrastructure

3.3. Project Decommissioning Phase

The turbine infrastructure which will be utilised for the proposed wind energy facility is expected to have a lifespan of approximately 20 - 30 years (with maintenance). Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility discussed in this EIA would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time. The following decommissioning activities have been considered to form part of the project scope.

3.3.1. Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate required equipment and lifting cranes, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of construction equipment.

3.3.2. Disassemble and Replace Existing Turbine

A large crane will be brought on site. It will be used to disassemble the turbine and tower sections. These components will be reused, recycled or disposed of in accordance with regulatory requirements. Almost all parts of the turbine would be considered reusable or recyclable except for the blades.

REGULATORY AND LEGAL CONTEXT CHAPTER 4

4.1 Policy and Planning Context for Wind Energy Facility Development in South Africa

The need to expand electricity generation capacity in South Africa is based on **national policy** and informed by on-going strategic planning undertaken by the Department of Energy (DoE). These policies are discussed in more detail in the following sections, along with the provincial and local policies or plans that have relevance to the proposed wind energy facility development.

4.1.1 The National Energy Act (2008)

The National Energy Act was promulgated in 2008 (Act No 34 of 2008). One of the objectives of the Act was to promote diversity of supply of energy and its sources. In this regard, the preamble makes direct reference to renewable resources, including wind:

"To ensure that diverse energy resources are available, in sustainable quantities, and at affordable prices, to the South African economy, in support of economic growth and poverty alleviation, taking into account environmental management requirements (...); to provide for (...) increased generation and consumption of renewable energies...(Preamble)."

The National Energy Act aims to ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, to the South African economy in support of economic growth and poverty alleviation, taking into account environmental management requirements and interactions amongst economic sectors, as well as matters relating to renewable energy. The Act provides the legal framework which supports the development of renewable energy facilities for the greater environmental and social good.

4.1.2 White Paper on the Energy Policy of the Republic of South Africa, 1998

Development within the energy sector in South Africa is governed by the White Paper on a National Energy Policy (the National Energy Policy), published by the then Department of Minerals and Energy (DME) in 1998. This White Paper identifies key objectives for energy supply within South Africa, such as increasing access to affordable energy services, managing energy-related environmental impacts and securing energy supply through diversity.

Investment in renewable energy initiatives, such as the proposed wind energy facility, is supported by the White Paper on Energy Policy for South Africa. In this regard the document notes that government policy is based on an understanding that renewable energy sources have significant medium- and long-term commercial potential and can increasingly contribute towards a long-term sustainable energy future in South Africa. The support for renewable energy policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and ***wind*** and that renewable applications are in fact the least cost energy service in many cases; more so when social and environmental costs are taken into account.

4.1.3 White Paper on the Renewable Energy Policy of the Republic of South Africa (2003)

The White paper on renewable energy supplements the Governments overarching policy on energy as set out in its White Paper on the Energy Policy of the republic of South Africa (DME, 1998). The White Paper on Renewable Energy Policy recognizes the significance of the medium and long-term potential of renewable energy. The main aim of the policy is to create the conditions for the development and commercial implementation of renewable technologies. The White Paper on Energy Policy's position with respect to renewable energy is based on the integrated resource planning criterion of:

"Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options."

This White Paper on Renewable Energy (November, 2003) sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. South Africa relies heavily on coal to meet its energy needs because it is well-endowed with coal resources; in particular. However South Africa is endowed with renewable energy resources that can be sustainable alternatives to fossil fuels, so far these have remained largely untapped. The White Paper on Renewable Energy sets a target of generating 10 000GWh from renewable energy sources. Therefore the policy supports the investment in renewable energy facilities sources at ensuring energy security through the diversification of supply.

The support for the Renewable Energy Policy is guided by a rationale that South Africa has a very attractive range of renewable resources, particularly solar and wind, and that renewable applications are, in fact, the least cost energy service in many cases from a fuel resource perspective (i.e. the cost of fuel in generating electricity from such technology) and more so when social and environmental costs are taken into account. In spite of this range of resources, the National Energy Policy acknowledges that the development and implementation of renewable energy applications has been neglected in South Africa.

Government policy on renewable energy is therefore concerned with meeting the following challenges:

» Ensuring that economically feasible technologies and applications are implemented;
» Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options; and
» Addressing constraints on the development of the renewable industry.

The White Paper on Renewable Energy states "*It is imperative for South Africa to supplement its existing energy supply with renewable energies to combat Global Climate Change which is having profound impacts on our planet*."

4.1.4 Final Integrated Resource Plan, 2010 - 2030

The Energy Act of 2008 obligates the Minister of Energy to develop and publish an integrated resource plan for energy. Therefore, the Department of Energy (DoE), together with the National Energy Regulator of South Africa (NERSA) has compiled the Integrated Resource Plan (IRP) for the period 2010 to 2030. The objective of the IRP is to develop a sustainable electricity investment strategy for generation capacity and transmission infrastructure for South Africa over the next twenty years. The IRP is intended to:

» Improve the long term reliability of electricity supply through meeting adequacy criteria over and above keeping pace with economic growth and development;
» Ascertain South Africa's capacity investment needs for the medium term business planning environment;
» Consider environmental and other externality impacts and the effect of renewable energy technologies;
» Provide the framework for Ministerial determination of new generation capacity (inclusive of the required feasibility studies)

The objective of the IRP is to evaluate the security of supply, and determine the least-cost supply option by considering various demand side management and supply-side options. The IRP also aims to provide information on the opportunities for investment into new power generating projects.

The outcome of the process confirmed that coal-fired options are still required over the next 20 years and that additional base load plants will be required from 2010. The first and interim IRP was developed in 2009 by the Department of Energy. The initial four years of this plan was promulgated by the Minister of Energy on 31 December 2009, and updated on 29 January 2010. The Department of Energy released the Final IRP in March 2011, which was accepted by Parliament at the end of March. This Policy-Adjusted IRP is recommended for adoption by Cabinet and subsequent promulgation as the final IRP. In addition to all existing and committed power plants (including 10 GW committed coal), the plan includes 9.6 GW of nuclear; 6.3 GW of coal; 17.8 GW of renewables (including wind ; and8.9 GW of other generation sources.

4.1.5 Electricity Regulation Act, 2006

Under the National Energy Regulator Act, 2004 (Act No 40 of 2004), the Electricity Regulation Act, 2006 (Act No 4 of 2006) and all subsequent relevant Acts of Amendment, NERSA has the mandate to determine the prices at and conditions under which electricity may be supplied by licence to Independent Power Producers (IPPs). NERSA has recently awarded electricity generation licences for new generation capacity projects under the REIPPP programme.

4.2. Regulatory Hierarchy for Energy Generation Projects

The South African energy industry is evolving rapidly, with regular changes to legislation and industry role-players. The regulatory hierarchy for an energy generation project of this nature consists of three tiers of authority who exercise control through both statutory and non-statutory instruments – that is National, Provincial and Local levels.

At **National Level**, the main regulatory agencies are:

» *Department of Energy:* This department is responsible for policy relating to all energy forms, including renewable energy, and are responsible for forming and approving the IRP (Integrated Resource Plan for Electricity). Wind energy is considered under the White Paper for Renewable Energy (2003) and the Department undertakes research in this regard. It is the controlling authority in terms of the Electricity Regulation Act (Act No 4 of 2006).

» *National Energy Regulator of South Africa (NERSA):* This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for wind energy developments to generate electricity.
» *Department of Environmental Affairs (DEA):* This Department is responsible for environmental policy and is the controlling authority in terms of NEMA and the EIA Regulations. DEA is the competent authority for this project, and charged with granting the relevant environmental authorisation.
» *Department of Transport and Public Works:* This department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *Department of Transport - Civil Aviation Authority:* This department is responsible for aircraft movements and radar, which are aspects that influence wind energy development location and planning.
» *The South African Heritage Resources Agency (SAHRA):* The National Heritage Resources Act (Act No 25 of 1999) and the associated provincial regulations provides legislative protection for listed or proclaimed sites, such as urban conservation areas, nature reserves and proclaimed scenic routes.
» *South African National Roads Agency Limited (SANRAL):* This department is responsible for all National road routes.
» *National Department of Agriculture, Forestry, and Fisheries (DAFF):* This Department is responsible for activities pertaining to subdivision and rezoning of agricultural land. The forestry section is responsible for the protection of tree species under the National Forests Act (Act No 84 of 1998).
» *National Department of Water Affairs:* This Department is responsible for water resource protection, water use licensing and permits. This area of the Northern Cape is not generally authorised, so applications go through the National Department.
» *Eskom:* Commenting authority regarding Eskom infrastructure and grid connection.
» *Department of Science and technology: The site occurs in the Northern Cape within the* Square Kilometre Array (SKA) regional area. Therefore, comment on the wind application from the SKA project is required in terms of the Astronomy Geographic Advantage Act (Act No. 21 of 2007).

At **Provincial Level**, the main regulatory agencies are:

» *Provincial Government of the Northern Cape – Department of Environmental and Nature Conservation (NC DENC):* This Department is the commenting authority for these projects.
» *Department of Transport and Public Works:* This Department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.

» *Provincial Department of Water Affairs:* This Department is responsible for water resource protection, water use licensing and permits.
» *Ngwao Boswa ya Kapa Bokone (Northern Cape Heritage Authority):* This body is responsible for commenting on heritage related issues in the Northern Cape Province.
» *Northern Cape Department of Agriculture, Land Reform and Rural Development:* This Department is responsible for all matters which affect agricultural land.
» *Northern Cape Department of Mineral Resources (DMR):* Approval from the DMR may be required to use land surface contrary to the objects of the Act in terms of section 53 of the Mineral and Petroleum Resources Development Act, (Act No 28 of 2002): In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resource that might occur on site.

At **Local Level** the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. In the Northern Cape, both Municipalities i.e. *Karoo Hoogland Local Municipality* and District Municipalities i.e. *Namakwa District Municipality* play a role.

» In terms of the Municipal Systems Act (Act No 32 of 2000) it is compulsory for all municipalities to go through an Integrated Development Planning (IDP) process to prepare a five-year strategic development plan for the area under their control.
» Bioregional planning involves the identification of priority areas for conservation and their placement within a planning framework of core, buffer and transition areas. These could include reference to visual and scenic resources and the identification of areas of special significance, together with visual guidelines for the area covered by these plans.
» By-laws and policies have been formulated by local authorities to protect visual and aesthetic resources relating to urban edge lines, scenic drives, special areas, signage, communication masts, etc.

There are also numerous non-statutory bodies such as Wind Energy Associations and environmental lobby groups that play a role in various aspects of planning and the environment that will influence wind energy development.

4.3 Legislation and Guidelines that have informed the preparation of this EIA Report

The following legislation and guidelines have informed the scope and content of this EIA Report:

» National Environmental Management Act (Act No 107 of 1998)
» EIA Regulations, published under Chapter 5 of the NEMA (GN R543, GN R544 and GN R546 in Government Gazette 33306 of 18 June 2010)
» Guidelines published in terms of the NEMA EIA Regulations, in particular:
  * Guideline 3: General Guide to Environmental Impact Assessment Regulations, 2006 (DEAT, June 2006)
  * Guideline 4: Public Participation in support of the Environmental Impact Assessment Regulations, 2006 (DEAT, May 2006)
  * Guideline 5: Assessment of alternatives and impacts in support of the Environmental Impact Assessment Regulations, 2006 (DEAT, June 2006)
  * Public Participation in the EIA Process (DEA, 2010)
  * Integrated Environmental Management Information Series (published by DEA)
» International guidelines – the Equator Principles and the International Finance Corporation and World Bank Environmental, Health, and Safety Guidelines for Wind Energy (2007)

Several other Acts, standards, or guidelines have also informed the project process and the scope of issues addressed and assessed in the EIA Report. A review of legislative requirements applicable to the proposed project is provided in the table in Table 4.1.

Table 3.1: Relevant legislative permitting requirements applicable to the Phase 1 – Phase 3 of the Hidden Valley Wind Energy Facility Project

Legislation / Policy / Guideline	**Applicable Requirements**	**Relevant Authority**	**Compliance requirements**
National Legislation			
National Environmental Management Act (Act No 107 of 1998)	EIA Regulations have been promulgated in terms of Chapter 5. Activities which may not commence without an environmental authorisation are identified within these Regulations. In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. In terms of GNR 387 of 21 April 2006, a scoping and EIA process is required to be undertaken for the proposed project	» National Department of Environmental Affairs » Department of Environmental and Nature Conservation (DENC) – commenting authority	This EIA report is to be submitted to the DEA and Provincial Environmental Department in support of the application for authorisation.
National Environmental Management Act (Act No 107 of 1998)	In terms of the Duty of Care provision in S28(1) the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project	Department of Environmental Affairs (as regulator of NEMA).	While no permitting or licensing requirements arise directly by virtue of the proposed project, this section will find application during the EIA phase and will continue to apply throughout the life cycle of the

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	is avoided, stopped or minimised. In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.		project.
National Environmental Management: Waste Act (Act No 59 of 2008)	The Minister may by notice in the Gazette publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. The Minister may amend the list by – » Adding other waste management activities to the list. » Removing waste management activities from the list. » Making other changes to the particulars on the list. In terms of the Regulations published in terms of this Act (GN 912), a Basic Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities. Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that:	National Department of Water and Environmental Affairs (hazardous waste) Provincial Department of Environmental Affairs (general waste)	A waste license is required for the ash dump associated with the power station. General waste handling, storage and disposal during construction and operation is required to be undertaken in accordance with the requirements of the Act, as detailed in the EMPr for the project (refer to Appendix P). The DWAF (1998) Waste Management Series. Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste will also need to be considered.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	» The containers in which any waste is stored, are intact and not corroded or in » any other way rendered unlit for the safe storage of waste. » Adequate measures are taken to prevent accidental spillage or leaking. » The waste cannot be blown away. » Nuisances such as odour, visual impacts and breeding of vectors do not arise; and » Pollution of the environment and harm to health are prevented.		
Environment Conservation Act (Act No 73 of 1989)	In terms of section 25 of the ECA, the national noise-control regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations. Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996, legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Free	National Department of Environmental Affairs Provincial Environmental Department - commenting authority. Local authorities Local Municipality	There is no requirement for a noise permit in terms of the legislation. A Noise Impact Assessment is required to be undertaken in accordance with SANS 10328 – this has been undertaken as part of the EIA process (refer to Appendix K). There are noise level limits which must be adhered to.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	State, Western Cape and Gauteng provinces, but the Northern Cape province have not yet adopted provincial regulations in this regard. Allows the Minister of Environmental Affairs to make regulations regarding noise, among other concerns		
National Water Act (Act No 36 of 1998)	Water uses must be licensed unless such water use falls into one of the categories listed in S22 of the Act or falls under general authorisation in terms of S39 and GN 1191 of GG 20526 October 1999. In terms of Section 19, the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to prevent and remedy the effects of pollution to water resources from occurring, continuing or recurring.	Department of Water Affairs	A water use permits or licenses are required to be applied for or obtained, if infrastructure such as access roads cross drainage lines.
National Water Act (Act No 36 of 1998)	In terms of Section 19, the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to prevent and remedy the effects of pollution to water resources from occurring, continuing or recurring.	Department of Water Affairs (as regulator of NWA)	While no permitting or licensing requirements arise directly by virtue of the proposed project, this section will find application during the EIA phase and will continue to apply throughout the life cycle of the project.
Minerals and Petroleum	A mining permit or mining right may be	Department of Mineral	If borrow pits are required for the

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
Resources Development Act (Act No 28 of 2002)	required where a mineral in question is to be mined (e.g. materials from a borrow pit) in accordance with the provisions of the Act. Requirements for Environmental Management Programmes and Environmental Management Plans are set out in Section 39 of the Act.	Resources	construction of the facility, a mining permit or right is required to be obtained.
National Environmental Management: Air Quality Act (Act No 39 of 2004)	Sections 18, 19 and 20 of the Act allow certain areas to be declared and managed as "priority areas" in terms of air quality. Declaration of controlled emitters (Part 3 of Act) and controlled fuels (Part 4 of Act) with relevant emission standards. Section 34 makes provision for: (1) the Minister to prescribe essential national noise standards - (a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or (b) for determining – (i) a definition of noise (ii) the maximum levels of noise (2) When controlling noise the provincial and local spheres of government are bound by any prescribed national	National Department of Environmental Affairs – air quality Local Municipality - Noise	No permitting or licensing requirements applicable for air quality aspects. The section of the Act regarding noise control is in force, but no standards have yet been promulgated. Draft regulations have however, been promulgated for adoption by Local Authorities. An atmospheric emission licence issued in terms of section 22 may contain conditions in respect of noise. This will however, not be relevant to the facility, as no atmospheric emissions will take place. The Act provides that an air quality officer may require any person to

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	standards. » The Draft National Dust Control Regulations prescribe measures for the control of dust in all areas including residential and light commercial areas. »		submit an atmospheric impact report if there is reasonable suspicion that the person has failed to comply with the Act.
National Heritage Resources Act (Act No 25 of 1999)	Section 38 states that Heritage Impact Assessments (HIAs) are required for certain kinds of development including » the construction of a road, power line, pipeline, canal or other similar linear development or barrier exceeding 300 m in length; » any development or other activity which will change the character of a site exceeding 5 000 m^2 in extent. The relevant Heritage Resources Authority must be notified of developments such as linear developments (such as roads and power lines), bridges exceeding 50 m, or any development or other activity which will change the character of a site exceeding 5 000 m^2; or the re-zoning of a site exceeding 10 000 m^2 in extent. This notification must be provided in the early stages of initiating that development, and	South African Heritage Resources Agency (SAHRA) – National heritage sites (grade 1 sites) as well as all historic graves and human remains.	Section 4 of the NHRA provides that within 14 days of receipt of notification the relevant Heritage Resources Authority must notify the proponent to submit an impact assessment report if they believe a heritage resource may be affected. A permit may be required should identified cultural/heritage sites on site be required to be disturbed or destroyed as a result of the proposed development.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	details regarding the location, nature and extent of the proposed development must be provided. Standalone HIAs are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils the provisions of Section 38. In such cases only those components not addressed by the EIA should be covered by the heritage component.		
National Environmental Management: Biodiversity Act (Act No 10 of 2004)	» Provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process (S53) » A list of threatened & protected species has been published in terms of S 56(1) - Government Gazette 29657. » Three government notices have been published, i.e. GN R 150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R 151 (Lists of critically endangered, vulnerable and protected species) and GN R 152 (Threatened or Protected Species Regulations). » Provides for listing threatened or protected ecosystems, in one of four	National Department of Environmental Affairs	As the applicant will not carry on any restricted activity, as is defined in Section 1 of the Act, no permit is required to be obtained in this regard. Specialist ecological studies are required to be undertaken as part of the EIA process. These studies have been undertaken as part of the previously EIAs undertaken for the site. A specialist ecological assessment has been undertaken for the proposed project (refer to Appendix F). A permit may be required should any protected plant species on site

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GoN 1002), 9 December 2011). » This Act also regulates alien and invader species. » Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. The developer has a responsibility for: » The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as		be disturbed or destroyed as a result of the proposed development.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	specified in the EIA regulations). » Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity. » Limit further loss of biodiversity and conserve endangered ecosystems.		
Conservation of Agricultural Resources Act (Act No 43 of 1983)	Regulation 15 of GNR1048 provides for the declaration of weeds and invader plants, and these are set out in Table 3 of GNR1048. Declared Weeds and Invaders in South Africa are categorised according to one of the following categories: » Category 1 plants: are prohibited and must be controlled. » Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread. » Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as	Department of Agriculture, Forestry and Fisheries	While no permitting or licensing requirements arise from this legislation, this Act will find application during the EIA phase and will continue to apply throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies must be developed and implemented. In addition, a weed control and management plan must be implemented. The permission of agricultural authorities will be required if the Project requires the draining of vleis, marshes or water sponges on land

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands. These regulations provide that Category 1, 2 and 3 plants must not occur on land and that such plants must be controlled by the methods set out in Regulation 15E.		outside urban areas.
National Veld and Forest Fire Act (Act 101 of 1998)	In terms of Section 12 the applicant would be obliged to burn firebreaks to ensure that should a veld fire occur on the property, that it does not spread to adjoining land. In terms of section 13 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material. In terms of section 17, the applicant must have such equipment, protective clothing and trained personnel for extinguishing fires.		While no permitting or licensing requirements arise from this legislation, this act will find application during the operational phase of the project. Due to the fire prone nature of the area, it must be ensured that the landowner and developer are part of the local Fire Protection Agency.
National Forests Act (Act No 84 of 1998)	Protected trees: According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected.	Department of Agriculture, Forestry and Fisheries	A permit or license is required for the destruction of protected tree species and/or indigenous tree

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	The prohibitions provide that ' no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'. Forests: Prohibits the destruction of indigenous trees in any natural forest without a licence.		species within a natural forest.
Aviation Act (Act No 74 of 1962) 13th amendment of the Civil Aviation Regulations (CARS) 1997	Any structure exceeding 45m above ground level or structures where the top of the structure exceeds 150m above the mean ground level, the mean ground level considered to be the lowest point in a 3km radius around such structure. Structures lower than 45m, which are considered as a danger to aviation shall be marked as such when specified. Overhead wires, cables etc., crossing a river, valley or major roads shall be marked and in addition their supporting towers marked and lighted if an aeronautical study indicates it could constitute a hazard to aircraft. Section 14 of Obstacle limitations and	Civil Aviation Authority (CAA)	While no permitting or licence requirements arise from the legislation, this act will find application during the operational phase of the project. Appropriate marking is required to meet the specifications as detailed in the CAR Part 139.01.33.

Legislation / Policy / Guideline	**Applicable Requirements**	**Relevant Authority**	**Compliance requirements**
	marking outside aerodrome or heliport – CAR Part 139.01.33 relates specifically to appropriate marking of wind energy facilities.		
Hazardous Substances Act (Act No 15 of 1973)	This Act regulates the control of substances that may cause injury, or ill health, or death by reason of their toxic, corrosive, irritant, strongly sensitising or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products. » Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc., nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared to be Group I or Group II hazardous substance; » Group IV: any electronic product;	Department of Health	It is necessary to identify and list all the Group I, II, III and IV hazardous substances that may be on the site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	» Group V: any radioactive material. The use, conveyance or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.		
National Road Traffic Act (Act No 93 of 1996)	The Technical Recommendations for Highways (TRH 11): “Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads” outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges and culverts. The general conditions, limitations and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass	Provincial Department of Transport (provincial roads) South African National Roads Agency Limited (national roads)	An abnormal load/vehicle permit may be required to transport the various components to site for construction. These include: » Route clearances and permits will be required for vehicles carrying abnormally heavy or abnormally dimensioned loads. » Transport vehicles exceeding the dimensional limitations (length) of 22m. » Depending on the trailer configuration and height when loaded, some of the power station components may not meet specified dimensional limitations (height and width).

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	distribution and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations.		
Development Facilitation Act (Act No 67 of 1995)	Provides for the overall framework and administrative structures for planning throughout the Republic. Sections 2- 4 provide general principles for land development and conflict resolution.	Karoo Hoogland Local Municipality	The applicant must submit a land development application in the prescribed manner and form as provided for in the Act. A land development applicant who wishes to establish a land development area must comply with procedures set out in the DFA.
Subdivision of Agricultural Land Act (Act No 70 of 1970)	Details land subdivision requirements and procedures. Applies for subdivision of all agricultural land, or for the registration of a lease for longer than 10 years.	Consent of Minister of Agriculture to subdivide, or register long lease or servitude, in respect of agricultural land.	Subdivision will have to be in place prior to any subdivision approval in terms of in terms of Section 24 and 17 of LUPO. Subdivision is required to be undertaken following the issuing of an environmental authorisation for the proposed project.
Promotion of Access to Information Act (Act No 2 of 2000)	» All requests for access to information held by state or private body are provided for in the Act under S11.	National Department of Environmental Affairs (DEA)	No permitting or licensing requirements. This act may find application during through the project EIA.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
Promotion of Administrative Justice Act (Act No 3 of 2000)	» In terms of Section 3 the government is required to act lawfully and take procedurally fair, reasonable and rational decisions » Interested & affected parties have right to be heard	National Department of Environmental Affairs (DEA)	No permitting or licensing requirements. This act will find application during through the project EIA.
Provincial Legislation / Policies / Plans			
Northern Cape Nature Conservation Act, 2009	To provide for the sustainable utilisation of wild animals, aquatic biota and plants; to provide for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; to provide for offences and penalties for contravention of the Act; to provide for the appointment of nature conservators to implement the provisions of the Act; to provide for the issuing of permits and other authorisations; and to provide for matters connected therewith.	Northern Cape Department of Environmental Affairs and Nature Conservation	The owner of land upon which an invasive species is found, must take the necessary steps to eradicate or destroy such species.
Astronomy Geographic Advantage Act (Act 21 of 2007)	» Preservation and protection of areas within South Africa that are uniquely suited for optical and radio astronomy. » Regulations promulgated in terms of AGA in 2009 require all developments in the Sutherland area that entail external night lighting, to be fully cut-off, with no	Department of Science and Technology	No permitting or licensing requirements.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	light emitted in the upward direction. This is aimed at protecting the observational integrity of SALT (Southern African Large Telescope), the largest telescope in the Southern Hemisphere, located approximately 20 km east of Sutherland. » In terms of section 7(1) and 7(2) of this Act, the Minister declared core astronomy advantage areas on 20 August 2010 under Regulation No. 723 of Government Notice No. 33462. in this regard, all land within a 3 kilometres radius of the centre of the Southern African large Telescope dome falls under the Sutherland Core Astronomy Advantage Area. The declaration also applies to the core astronomy advantage area containing the MeerKAT radio telescope and the core of the planned Square Kilometre Array (SKA) radio telescope. The study area does not fall within the 3 km radius of SALT or within an area which could affect the MeerKAT and SKA developments. » Under Section 22(1) of the Act the		

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	Minister has the authority to protect the radio frequency spectrum for astronomy observations within a core or central astronomy advantage area. As such, the Minister may still under section 23(1) of the Act, declare that no person may undertake certain activities within a core or central astronomy advantage area. These activities include the construction, expansion or operation of any fixed radio frequency interference source, facilities for the generation, transmission or distribution of electricity, or any activity capable of causing radio frequency interference or which may detrimentally influence the astronomy and scientific endeavour.		
Local Legislation / Policies / Plans			
Karoo Hoogland Local Municipality Integrated Development Plan (IDP)	» The IDP notes that the Karoo Hoogland is primarily an agricultural community. Conservation of the environment and sustainable development are identified as primary points of departure in policy. » The main socio-economic developmental issues are identified as widespread poverty, the lack of employment opportunities, low adult literacy levels,	Karoo Hoogland Local Municipality	» New developments in the municipality to be in line with the IDP.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	and general the lack of diversified skills amongst the bulk of the population. School dropout rates are pronounced. The IDP describes general living conditions in the LM as "some of the worst in the country".		
Standards			
Noise Standards	Four South African Bureau of Standards (SABS) scientific standards are considered relevant to noise from a Wind Energy Facility. They are: » SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'. » SANS 10210:2004. 'Calculating and predicting road traffic noise'. » SANS 10328:2008. 'Methods for environmental noise impact assessments'. » SANS 10357:2004. 'The calculation of sound propagation by the Concave method'. The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels	Local Municipality	The recommendations that the standards make are likely to inform decisions by authorities, but non-compliance with the standards will not necessarily render an activity unlawful per se.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes.		

4.3.1. Draft Future Regulations and Guidelines

» ***Noise Control Regulations***

In terms of section 25 of the Environment Conservation Act (No 89 of 1989), the national noise-control regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations. Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996, legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Free State, Western Cape and Gauteng provinces, but the Northern Cape Province have not yet adopted provincial regulations in this regard.

» Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (Jenkins et al 2011)

» South African good practice guidelines for surveying bats in wind farm developments. Endangered Wildlife Trust (Sowler, S. and Stoffberg, S. 2014)

APPROACH TO UNDERTAKING THE EIA PHASE — CHAPTER 5

An Environmental Impact Assessment (EIA) process refers to that process (dictated by the EIA Regulations) which involves the identification of and assessment of direct, indirect and cumulative environmental impacts associated with a proposed project. The EIA process comprises two phases: **Scoping Phase** and **EIA Phase**. The EIA process culminates in the submission of a Final EIA Report (including an environmental management programme (EMPr)) to the competent authority for decision-making. The EIA process is illustrated below:

The EIA Phase for the proposed Hidden Valley Wind Energy Facility (that is, the three phases: the Karusa wind farm, the Soetwater wind farm and the Great Karoo wind farm) has been undertaken in accordance with the EIA Regulations published in Government Notice GN33306 of 18 June 2010, in terms of Section 24(5) of NEMA (Act No. 107 of 1998). The environmental studies for this proposed project were undertaken in two phases, in accordance with the EIA Regulations.

A summary of the EIA timeline to date is as follows:

» EIA Application to DEA – October 2011
» Scoping Phase – 2011
» DEA acceptance of the Final Scoping Report – February 2012
» Draft EIA for Public Review – March 2012
» Final EIR submitted to DEA – May 2012
» DEA Site Visit – June 2012
» DEA request for updated layout and layout information – August 2012
» ACED submission of updated layout and layout information – December 2012

» Rejection of Final EIR Report by DEA based on the requirement to conduct bird and bat pre-construction monitoring as part of the environmental assessment process - May 2013
» 21 day public review period for the Amended Final EIA Report including results and predictions of the pre-construction bird and bat monitoring – 17 April 2014 – 16 May 2014.
» Submission of Amended Final EIA Report to DEA - May 2014

This chapter serves to outline the EIA process that was followed.

5.1. Phase 1: Scoping Study

The Scoping Study, which was concluded in February 2012 with the acceptance of the Scoping Report by DEA, provided I&APs with the opportunity to receive information regarding the proposed project, participate in the process and raise issues of concern.

The Scoping Report aimed at detailing the nature and extent of the proposed Hidden Valley Wind Energy Facility, identifying potential issues associated with the proposed project, and defining the extent of studies required within the EIA. This was achieved through an evaluation of the proposed project, involving the project proponent, specialist consultants, and a consultation process with key stakeholders that included both relevant government authorities and interested and affected parties (I&APs).

The draft Scoping Report compiled was made available at public places for I&AP review and comment from 02 November 2011 – 01 December 2011. All the comments, concerns and suggestions received during the Scoping Phase and the draft report review period were included in the final Scoping Report and Plan of Study for EIA. The Final Scoping Report was submitted to the National Department of Environmental Affairs (DEA) on 05 December 2011. The Final Scoping Report was accepted by the DEA in February 2012, as the competent authority (refer to Appendix B). In terms of this acceptance, an Environmental Impact Assessment was required to be undertaken for the proposed project in line with the Plan of Study for EIA as stated in the Scoping Report. DEA had accented the approach to asses all three development phases in one EIA report, with one consolidated public consultation process.

5.2. Phase 2: Environmental Impact Assessment

Through the Scoping Study, a number of issues requiring further study for all components of the project were highlighted. These issues have been assessed in detail within the EIA phase of the process.

The EIA Phase aims to achieve the following:

» Provide an overall assessment of the social and biophysical environments affected by the proposed alternatives put forward as part of the project.
» Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed Hidden Valley Wind Energy Facility.
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public involvement process to ensure that I&AP are afforded the opportunity to participate, and that their issues and concerns are recorded.

The EIA addresses potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with all phases of the project including design, construction, operation and decommissioning, and aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The EIA process followed for this project is described below.

5.3. Overview of the EIA Phase

The EIA Phase has been undertaken in accordance with the EIA Regulations June 2010, in terms of NEMA. Key tasks undertaken within the EIA phase included:

» Consultation with relevant decision-making and regulating authorities (at National, Provincial and Local levels).
» Undertaking a public participation process throughout the EIA process in accordance with Regulation 54 of GN R543 of 2010 in order to identify any additional issues and concerns associated with the proposed project.
» Preparation of a Comments and Response Report detailing key issues raised by I&APs as part of the EIA Process (in accordance with Regulation 57 of GN R543 of 2010).
» Undertaking of independent specialist studies in accordance with Regulation 32 of GN R543 of 2010.

» Preparation of a Draft EIA Report in accordance with the requirements of the Regulation 31 of GN R543 of 2010.

These tasks are discussed in detail below.

5.3.1. Authority Consultation

The National DEA is the competent authority for this application. A record of all authority consultation undertaken prior to the commencement of the EIA Phase is included within the Scoping Report and EIA report. Consultation with the regulating authorities (i.e. DEA and NC DENC) has continued throughout the EIA process. On-going consultation included the following:

» Submission of a Final Scoping Report (December 2011) following a public review period (and consideration of stakeholder comments received).
» Correspondence with DEA and NC DENC in order to clarify the findings of the Scoping Report and the issues identified for consideration in the EIA process.
» Submission of a Draft EIA report (March 2012)
» Submission of a Final EIA Report (April 2012) following a public review period (and consideration of stakeholder comments received).
» Site visit with DEA official (Mr R Nkosi) on 27 June 2012
» Meeting with DEA officials on 23 May 2013 to discuss the project and EIA process.

A record of all authority consultation undertaken prior to the commencement of the EIA Phase is included within the Scoping Report. A record of the authority consultation in the EIA process is included within **Appendix B.** The following is being undertaken as part of the EIA process:

» Consultation with Organs of State that may have jurisdiction over the project during the final review period for the amended Final EIA report:
  * Department of Environment and Nature Conservation
  * Department of Energy
  * Department of Water Affairs
  * Department of Agriculture, Forestry and Fisheries (DAFF)
  * Department of Mineral Resources (DMR)
  * South African Heritage Resources Agency (SAHRA)
  * Provincial Conservation Authorities
  * Department of Transport and Public Works and various District Roads Departments
  * South African National Roads Agency
  * Department of Land Affairs

  * Department of Science and Technology (Square Kilometre Array (SKA) project)
  * Civil Aviation Authority
  * Karoo Hoogland Local Municipality
  * Namakwa District Municipality
- Submission of an amended Final Environmental Impact Assessment (EIA) Report to DEA following a public review period.
- Provision of an opportunity for additional DEA and NC DENC representatives to visit and inspect the proposed site.

5.3.2. Public Involvement and Consultation: EIA Phase

The aim of the public participation process was primarily to ensure that:

- Information containing all relevant facts in respect of the proposed project was made available to potential stakeholders and I&APs.
- Participation by potential I&APs was facilitated in such a manner that all potential stakeholders and I&APs were provided with a reasonable opportunity to comment on the proposed project.
- Comment received from stakeholders and I&APs was recorded and incorporated into the EIA process.

Through on-going consultation with key stakeholders and I&APs, issues raised through the Scoping Phase for inclusion within the EIA study were confirmed. All relevant stakeholder and I&AP information has been recorded within a database of affected parties (refer to **Appendix C** for a listing of recorded parties). Adjacent landowners were identified and informed of the project (refer to landowner map in **Appendix E**). While I&APs were encouraged to register their interest in the project from the onset of the process, the identification and registration of I&APs has been on-going for the duration of the EIA process and the project database has been updated on an on-going basis.

In order to accommodate the varying needs of stakeholders and I&APs, as well as ensure the relevant interactions between stakeholders and the EIA specialist team, the following opportunities were provided for I&APs issues to be recorded and verified through the EIA phase, including:

- Focus group meetings (stakeholders invited to attend)
- Public meeting (advertised in the local press: Die Burger and Die Noordwester)
- Written, faxed or e-mail correspondence

Records of all consultation undertaken are included within **Appendix E.** In summary, the public participation process for this project has included the following key steps/activities to date:

Scoping Phase	**Advertisement of EIA Process – First round of adverts (Die Burger and Die Noordwester)**	**September 2011**
	Advertisement of Public Meeting & Availability of Scoping report for public review – Second round of adverts	November 2011
	Distribution of Background Information Document (BID) and written notice	October – November 2011
	Focus group & site meeting for key stakeholders	
	Public review period for DSR	
	Public meeting & stakeholder meetings » Date: 14 November 2011 , » Time: 16h30 » Venue: NG Kerk, Sutherland, Northern Cape Province	
	Notification to registered I&APs that the Final Scoping report was available & submitted to DEA	December 2011
EIA Phase	Advertisement of public review period for Draft EIA Report & Public meeting - (Die Burger and Die Noordwester)	March 2012
	Public meeting & stakeholder meetings » Date: 27 March 2012 » Time: 17h30 » Venue: NG Kerk, Sutherland, Northern Cape Province	
	Notification to registered I&APs that the Final EIA report was available & submitted to DEA	03 May 2012
	Public review period of the amended Final EIA Report	17 April 2014 – 16 May 2014.

5.3.4. Identification and Recording of Issues and Concerns

Issues and comments raised by I&APs to date over the duration of the EIA process have been synthesised into a Comments and Response Report (refer to **Appendix E** for the Comments and Response Report compiled from comments received during both the Scoping Phase and the EIA Phase).

The Comments and Response Reports include responses from members of the EIA project team and/or the project proponent. Where issues are raised that the EIA team considers beyond the scope and purpose of this EIA process, clear reasoning for this view is provided.

5.3.5. Assessment of Issues Identified through the Scoping Process

Issues which required further investigation within the EIA phase, as well as the specialists involved in the assessment of these impacts are indicated in the table below.

Area of Expertise	Specialist	Refer Appendix
Ecology: flora, fauna and wetlands	David Hoare of David Hoare Consulting cc	Appendix F
Avifauna (as included in the original EIA Report of 2012)	Andrew Pearson of the Endangered Wildlife Trust (EWT)	Appendix G
Soil and Agricultural Potential Specialist Study	Johan Van Der Waals of TerraSoil Science	Appendix H
Visual Impact Assessment	Lourens Du Plessis of MetroGIS	Appendix I
Heritage – Archaeology	Celeste Booth of the Albany Museum	Appendix J
Noise	Morne De Jager of MENCO	Appendix K
Social Impact	Tony Barbour of Tony Barbour Consulting	Appendix L
Desktop Palaeontology	Lloyd Rossouw of Paleo Field Services cc	Appendix M
Pre-construction bird monitoring and assessment report	Stephanie Aken of Endangered Wildlife Trust (EWT)	Appendix R
Pre-construction bat monitoring and assessment report	Werner Marias of Animalia cc	Appendix S

Specialist studies considered direct and indirect environmental impacts associated with the development of all components of the wind energy facility. Issues were assessed in terms of the following criteria:

» The **nature**, a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score of between 1 and 5 is assigned as appropriate (with a score of 1 being low and a score of 5 being high).
» The **duration**, wherein it is indicated whether:

   * the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
   * the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
   * medium-term (5–15 years) – assigned a score of 3;
   * long term (> 15 years) - assigned a score of 4; or
   * permanent - assigned a score of 5.
- » The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
   * 0 is small and will have no effect on the environment;
   * 2 is minor and will not result in an impact on processes;
   * 4 is low and will cause a slight impact on processes;
   * 6 is moderate and will result in processes continuing but in a modified way;
   * 8 is high (processes are altered to the extent that they temporarily cease); and
   * 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale, and a score assigned:
   * Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
   * Assigned a score of 2 is improbable (some possibility, but low likelihood);
   * Assigned a score of 3 is probable (distinct possibility);
   * Assigned a score of 4 is highly probable (most likely); and
   * Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).
- » The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- » The **status**, which is described as either positive, negative or neutral.
- » The degree to which the impact can be reversed.
- » The degree to which the impact may cause irreplaceable loss of resources.
- » The degree to which the impact can be mitigated.

The **significance** is determined by combining the criteria in the following formula:

S=(E+D+M)P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

As ACED has the responsibility to avoid or minimise impacts and plan for their management (in terms of the EIA Regulations), the mitigation of significant impacts is discussed. Assessment of impacts with mitigation is made in order to demonstrate the effectiveness of the proposed mitigation measures. Three separate draft Environmental Management Programmes are included as **Appendix N, O and P**.

5.3.6. Assumptions and Limitations

Wind energy facilities are a fairly new development in South Africa and have not been implemented on a large scale in the country, to date. Therefore certain gaps in knowledge, assumptions and uncertainties are likely to occur during the EIA process. These are discussed below.

In conducting this EIA process, the following general assumptions have been made:

» The technical motivation as to the selection of the proposed development site (including details pertaining to the wind resource, etc.) provided by ACED is sufficient and defendable.
» Only one site is available for the establishment of the proposed facility (and the three development phases of the project) and will be considered in the EIA, and no other sites are available to be included as alternative sites in the EIA. This is based on the detailed wind analysis (with specific measurements on site) which has been done to date, as well as on land availability, access to the site, grid connectivity, etc. It is assumed that the pre-feasibility study undertaken by ACED will be sufficient to motivate the selection of the site to DEA.
» It is assumed that the development site identified by ACED represents a technically suitable site for the establishment of a wind energy facility and associated infrastructure.
» It is assumed that the Komsberg Substation can accommodate the additional power generated from the wind energy facility.

» The EIA study was conducted based on a preliminary layout of the wind energy facility provided by ACED. It is understood that this layout is preliminary at this stage, but it is assumed that the layout is approximately 80% accurate, and subject to change based on the environmental sensitivities/outcomes from this EIA phase.

Details of specific assumptions, limitations and/ gaps in knowledge for each of the environmental aspects / specialist studies undertaken are briefly highlighted below (refer to specialist studies contained in **Appendix F- S** for more details).

5.3.7. Public Review of Draft EIA Report and Feedback Meeting

The Draft EIA report was made available for public review from **23 March 2012 - 23 April 2012** at the following locations:

» Sutherland Public Library, Sutherland
» Lord Milner Hotel, Matjiesfontein
» www.savannahSA.com

In order to provide feedback of the findings of the studies undertaken and receive comments to address in the draft EIA report, a public feedback meeting was held within the review period of the Draft EIA Report. All interested and affected parties were invited to attend the **public feedback meeting** (held on **28 March 2012** at the **NG Kerk, Sutherland, Northern Cape Province** at **17h30**).

All registered I&APs were notified of the availability of the report and public meeting by letter. Adverts were also placed in the Die Burger and Die Noordwester newspapers on 14 March 2012 (refer to **Appendix D**).

5.3.8. Public Review of the Amended Final EIA Report

This amended Final EIA Report for the Hidden Valley Wind Energy Facility has been released for a 21- day public review period, prior to submission of the final report to DEA. The public review period is from 17 April 2014 – 16 May 2014. Registered I&APs have been informed via letter that this amended Final EIA Report is available for comment, and that copies of the report can be requested from Savannah Environmental or downloaded from the website: www.savannahSA.com. The copy of the amended Final EIA report has also been placed at the Sutherland Public Library in Sutherland and at the Lord Milner Hotel in Matjiesfontein.

This amended Final EIA Report for the Hidden Valley Wind Energy Facility is to include the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes. In addition the following minor amendments to the project description have been made:

» One turbine was erroneously included in Phase 2 which is now included into Phase 1. Therefore, Phase 1 originally had 75 turbines, and now has 74 turbines. Phase 2 originally had 55 turbines, and now has 56 turbines.
» The numbering of turbines as indicated in the maps within the main EIA report (only) has changed. However, the locations of the turbines have not changed and the layout remains the same) as presented in the draft and final EIA published in 2012(apart from re-numbering of the turbines). The number of wind turbines for all three phases remains as 207 in total.
» Inclusion of a double-circuit power line up to 12km in length from the on-site substation to Komsberg Substation, all located within the project development footprint assessed through the EIA, in response to the grid connection option given to this project by Eskom (via the cost-estimate letter provided by Eskom for this project).

5.3.8. Final Amended Environmental Impact Assessment (EIA) Report

The final stage in the EIA Phase entails capturing of responses from I&APs on the Amended Final EIA Report in order to refine this report. This amended Final EIA report is submitted to the decision-making Authorities, and it is this amended Final report upon which a decision is made regarding the proposed project.

DESCRIPTION OF THE AFFECTED ENVIRONMENT CHAPTER 6

This section of the EIA Report provides a description of the environment that may be affected by the proposed three phases of the Hidden Valley wind energy facility (i.e. the phases being the Karusa Wind Farm, Soetwater Wind Farm and the Great Karoo Wind Farm respectively). Aspects of the biophysical, social and economic environment that could be directly or indirectly affected by, or could affect, the proposed development have been described. This information has been sourced from both existing information available for the area as well as site investigations, and aims to provide the context within which this EIA is being conducted. A more detailed description of each aspect of the affected environment is included within the specialist reports contained within **Appendices F - S**. The entire project development area (i.e. all three phases) is described below as the three phases are fairly uniform (and are located directly adjacent to each other). Where there are differences between the environments of the phases, this is highlighted. A summary of the environment of each of the three project development phases in provided at the end of this Chapter.

6.1 Location and Character of the Study Area

Regionally, the proposed site for the wind energy facility (i.e. comprising all 3 phases) is located 30km south of Sutherland and about 40km north of Laingsburg (at the closest points). The site is located wholly within the Northern Cape Province within the Karoo Hoogland Local Municipality. The site can be directly accessed via a gravel road (this gravel road traverses the broader study site) which joins the R354 main road to Sutherland. A small settlement called Matjiesfontein (located within the Western Cape Province) is also located 20 km south of the proposed site and is the closest settlement to the site, despite the town being located in the Western Cape. The area has a rural character and is dominated by sheep farming activities. The three phases of the wind energy facility are proposed on the following farm portions:

» **Phase 1 - Proposed Karusa Wind Farm** to be located on Farm De Hoop 202, Farm Standvastigheid 210, and Portion 1, 2, 3 and the remainder of Farm Rheebokke Fontein 209.
» **Phase 2 – Proposed Soetwater Wind Farm** to be located on the remainder of, and Portion 1, 2 and 4 of Farm Orange Fontein 203, Annex Orange Fontein 185, Farm Leeuwe Hoek 183 and Farm Zwanepoelshoek 184.
» **Phase 3 – Proposed Great Karoo Wind Farm** to be located on Farm Kentucky 206 and Portion 1 of Farm Wolvenkop 207.

The combined study area for the three phases of the project development encompasses a combined surface area of approximately 340km^2, broken down as follows for each Phase:

» Phase 1 - Proposed Karusa Wind Farm - 136.2 km^2
» Phase 2 – Proposed Soetwater Wind Farm - 95.3 km^2
» Phase 3 – Proposed Great Karoo Wind Farm - 91.8 km^2

The final footprint area to be utilised for the wind energy facility will be smaller than the area under consideration, and will be dependent on the final site layout and placement of the wind turbines and associated infrastructure. The study area does not include any towns or urban areas, but a number of structures occur scattered throughout the study area. Some of these are occupied residences or farming homesteads, while others are pump houses, ruins or stone walls (kraals).

An arterial road (i.e. the R354) runs in a north south direction to the west of the study site. A number of secondary roads traverse the study area in different directions. Three Eskom 400kV transmission lines (i.e. the Komsberg-Muldersvlei, the Bacchus-Komsberg and the Gamma-Omega 400kV power lines) traverse the southern section of the proposed development site. Another power line runs in a north-south direction to the east of the site. Eskom's Komsberg Substation is located close to the southern boundary of the Karusa Wind Farm site. These are illustrated in **Figure 6.1**.

The Southern African Large Telescope (SALT) observatory is located approximately 35km to the north-east of the site. The telescope, funded by a consortium of international partners (USA, Germany, the UK, Poland, India, etc.), was specifically located within this region due to the absence of light sources brought about by urban developments. The population density of the region is less than 1 person per km^2, and therefore the site is located in a sparsely populated region of the Northern Cape. The environment has remained in a natural state with little or no large-scale development. Sheep farming is the predominant land use activity. The study area has a harsh, rugged character with vast expanses of natural and undeveloped landscape.

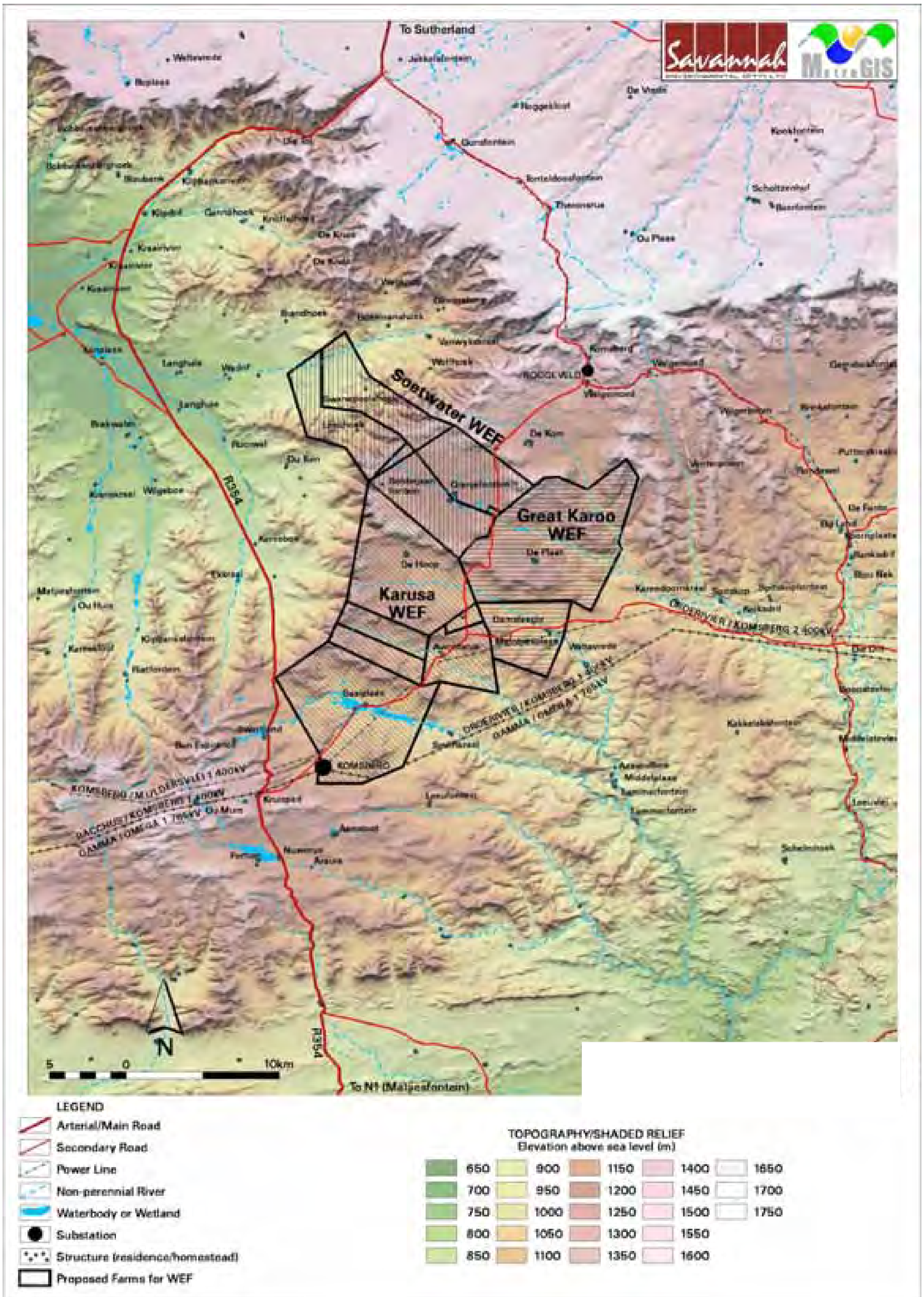

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Figure 6.1: Location of the proposed facility (3 phases) indicating shaded relief (topography and elevation above sea level) of the broader study area

6.2 Land Use and Land Capability

Sheep farming is the predominant land use activity on all three projects. The land-cover is described as being shrubland. A land cover / land-use map is shown in **Figure 6.2**. Figure 6.3 illustrates grazing pastures in the study area. Irrigated agriculture occurs sporadically in localised floodplains in valley bottoms and is usually associated either with flood or sprinkler (and limited centre pivot) irrigation. The land capability of the site can be considered to be "wilderness" as the grazing capacity is low enough that only natural land uses and low intensity grazing occurs.

6.3 Climate

The climate is in the Karoo region varies from arid to semi-arid. Rainfall may fall at any time of the year, although there is a peak in autumn / winter on the lowlands and slightly earlier (March) on the uplands. Mean temperatures of the mountainous regions are generally lower than the plains to the south of the escarpment. Frost is a common phenomenon in the mountainous areas with up to 50 days of frost per year. Mean annual rainfall is between 180 mm to 430 mm per year.

Altitude has a strong influence on most climatic variables. Generally, an increase in altitude corresponds with a decrease in temperature and an increase in rainfall. Mountains also have an orographic influence on rainfall, escarpment zones usually experiencing increased rainfall and mists, depending on aspect, cause either an increase or decrease in mean daily insolation levels. The study site is located just south of the Great Escarpment and the climate is therefore strongly influenced by the presence of these mountains. All areas with less than 400 mm rainfall are considered to be arid. The parts of the study area along the Klein Roggeveldberge can therefore be considered to be semi-arid. The remaining areas can be considered to be arid.

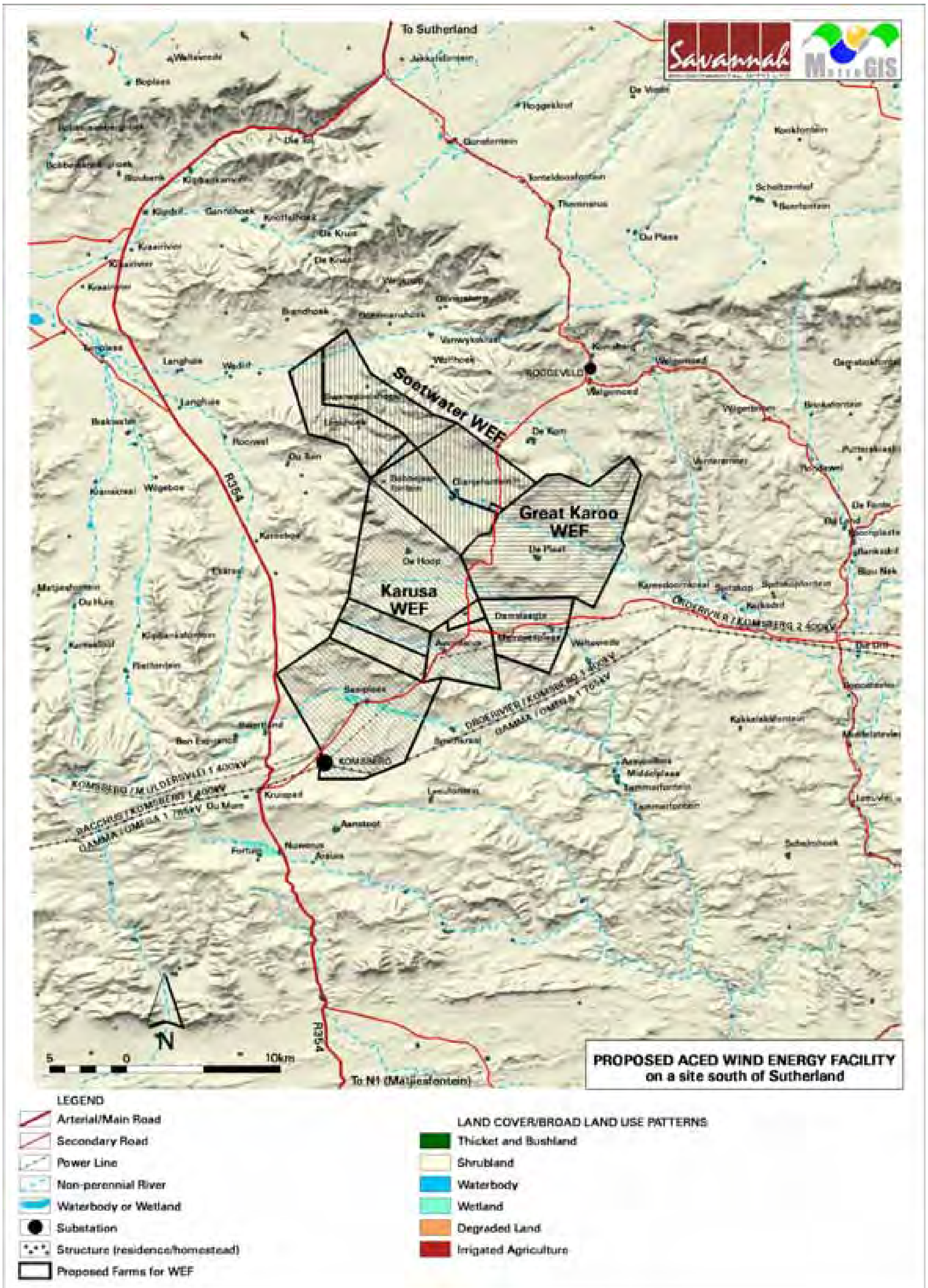

Figure 6.2: Land cover/land use map of the study area in the Northern Cape, indicating that the full extent of the larger study area is considered to be shrubland

Figure 6.3 Photograph illustrating grazing pasture in the study area

6.4 Topography

The topography of all three projects is similar. Mountainous terrain within the southern part of the study area (Karusa and Great Karoo phases) is concentrated in a band extending from the escarpment toward the south-west, effectively forming a watershed between the north-west and the south-east. The proposed wind energy facility is located within the band of mountainous terrain, below the escarpment. The terrain adjacent to the proposed wind energy facility is mountainous to the north-east and south-west, with the hilly terrain abating somewhat in the north-west and south-east. The terrain type of the region is described as low mountains for the most part, with escarpment giving rise to mountains and lowlands in the north-east. The study site is located in the rugged terrain which is south of the Great Escarpment. The Klein Roggeveldberge runs in an approximately north-south direction through the site. The site is therefore steeply undulating to rugged. The elevation varies from 824 m to 1412 m above sea level for all phases of the project.

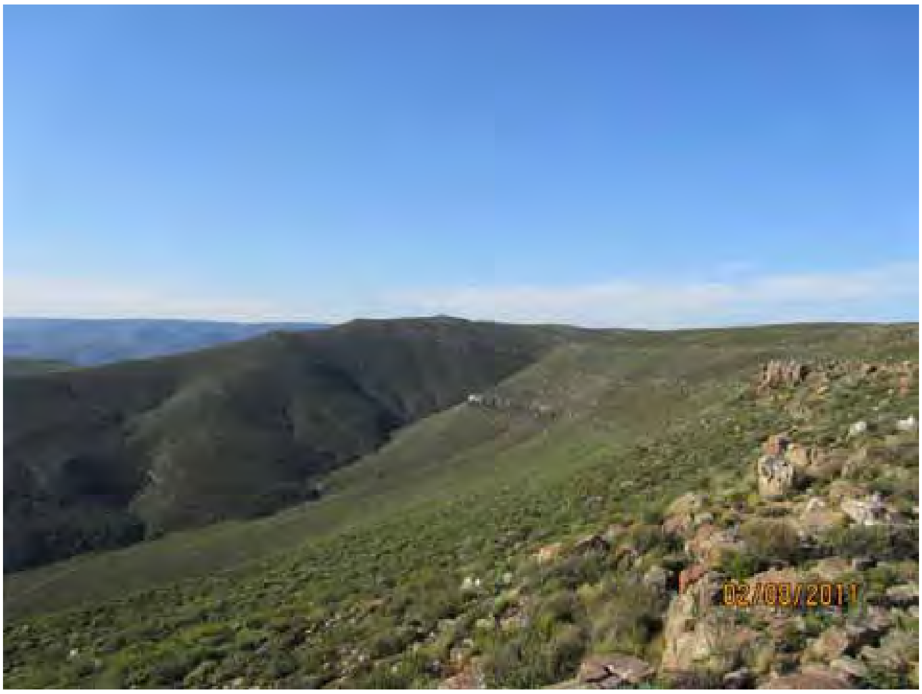

Figure 6.4: Photograph illustrating the nature of the hills and ridges characteristic of the larger study site

6.5 Hydrology, Wetlands, Riparian Zones and Watercourses

All three phases of the site have drainage lines traversing the site. The low mountains are dissected by small river valleys in which perennial or non-perennial streams are found. Most of the site is underlain by mudstone and arenite of the Beaufort Group of the Karoo Supergroup. The entire site is in the catchment of the Meintjiesplaas River, which flow into the Buffels River before passing through the town of Laingsburg. There are wetlands and a large number of drainage lines dissecting the landscape, most of which are dry or non-perennial. These drainage lines and wetlands occur within all three phases of the project, the main watercourses on the site are shown in **Figure 6.5**. These drain into more significant riparian areas, some of which contain flowing water for significant parts of the year. In terms of legislation, wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). In addition they are also regarded as sensitive habitats in the National Environmental Management Act implying that they are afforded a higher level of protection. A "watercourse" in terms of the National Water Act (act 36 of 1998) means:

» River or spring;
» A natural channel in which water flows regularly or intermittently;

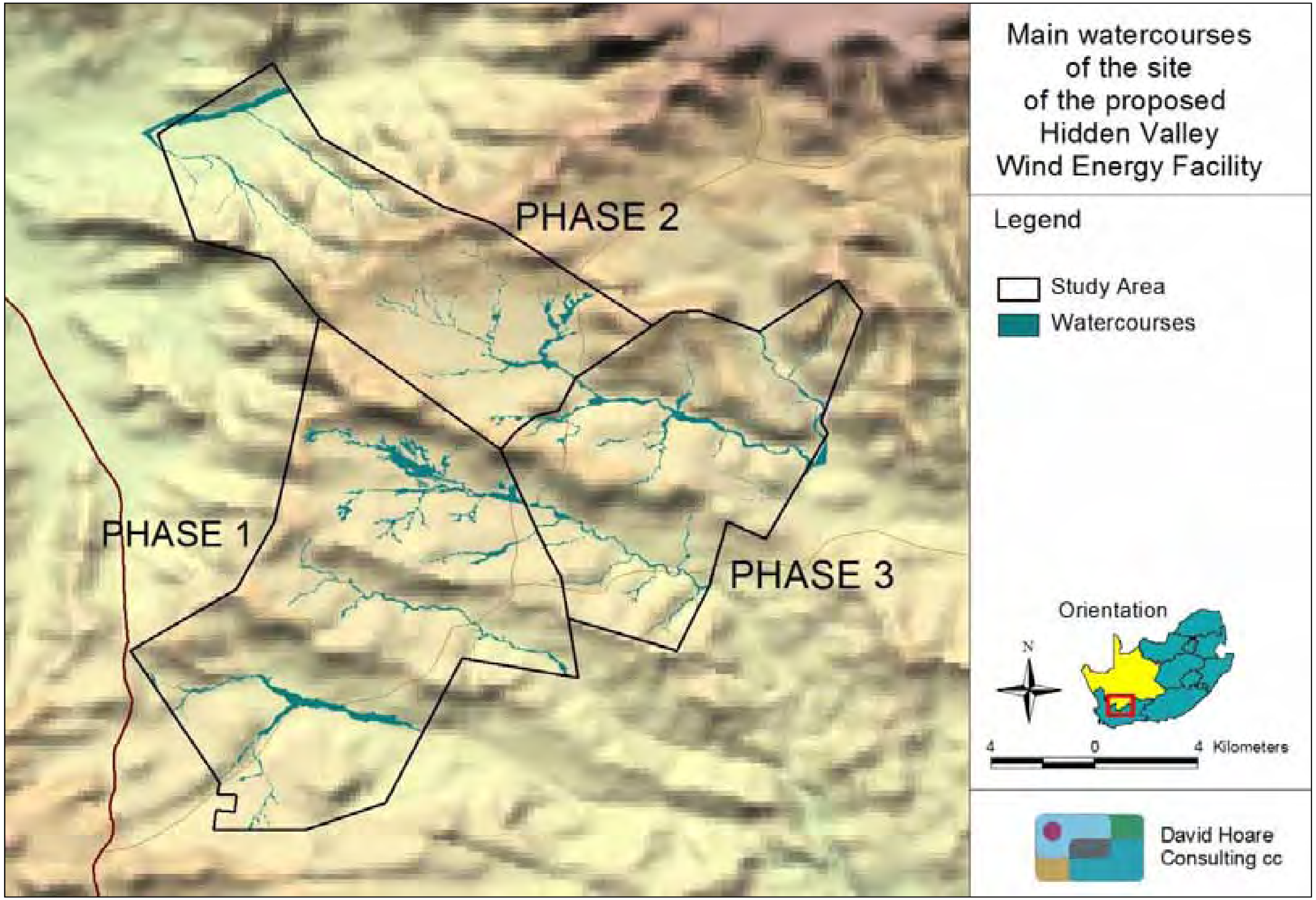

Figure 6.5: Main watercourses that occur on the three project development phases

» A wetland, lake or dam into which, or from which, water flows; and
» Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

6.6 Conservation Planning

6.6.1 Important Biodiversity Areas

No major conservation or ecological protected areas (either statutory or private) were identified on either of the three project phases.

Though the regional conservation assessments produced within the Northern Cape Province, patterns and processes that are important for maintaining biodiversity in the region have been identified. These assessment include the following:
» Succulent Karoo Ecosystems Programme (SKEP)
» National Spatial Biodiversity Assessment (NSBA)
» Namakwa District Biodiversity Sector Plan (NDBSP)
» Cape Action for People and the Environment (CAPE)

Some of these studies have been done using coarse-scale satellite imagery that does not provide spatial or spectral accuracy at the scale required for detailed EIA studies. They are, however, useful for understanding broad issues and patterns within the area. The Namakwa District Biodiversity Sector Plan (NDBSP) has integrated previous studies and is a useful reference for identifying conservation issues in the study area and surrounds.

The NDBSP identifies Critical Biodiversity Areas (CBAs), which are terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning (Desmet *et al* 2009). The NDBSP identifies CBAs at different levels with decreasing biodiversity importance, as follows:

1. PA: Protected areas.
2. T1: Critical vegetation types and irreplaceable biodiversity areas (areas definitely required to meet conservation targets), critical sites for species.
3. T2: EN (Endangered) and VU (Vulnerable) vegetation types, important terrestrial habitats (e.g. quartz patches, steep, south-facing slopes larger than 25 ha in size, kloofs, habitat for riverine rabbit), other important biodiversity areas that do not fall into T1.
4. ESA_T: Ecological support areas, including corridors.
5. ONA: Other natural areas. Remaining natural areas that do not fall within one of the categories described above.

6. Transformed: No natural habitat remaining

Within the study area, the NDBSP identifies one CBA that occurs within the study area and surroundings (refer to **Figure 6.6**). These are the T2 areas that fall within the broader wind energy facility study site are steep slopes and Roggeveld kloofs.

The National Protected Areas Expansion Strategy (NPAES) is another document that must be taken into account in evaluating biodiversity value of the site. The goal of the NPAES is to achieve cost-effective protected area expansion for ecological sustainability and increased resilience to climate change. It sets targets for protected area expansion, provides maps of the important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. The NPAES uses two factors, *importance and urgency*, to identify priority areas for protected area expansion in the terrestrial environment. An area is considered *important* for the expansion of the land-based protected area network if it contributes to meeting biodiversity thresholds for terrestrial or freshwater ecosystems, maintaining ecological processes or climate change resilience. *Urgency*, the second factor used to identify priority areas for protected area expansion, is determined by the extent to which spatial options for meeting protected area targets still exist. All three phases of the site have been identified as falling within areas that are considered priority areas for the NPAES, as shown in **Figure 6.6.** All three phases of the development have T2 CBA types i.e. either and Endangered or and Vulnerable vegetation type, important terrestrial habitats or other important biodiversity areas that do not fall into the T1 category.

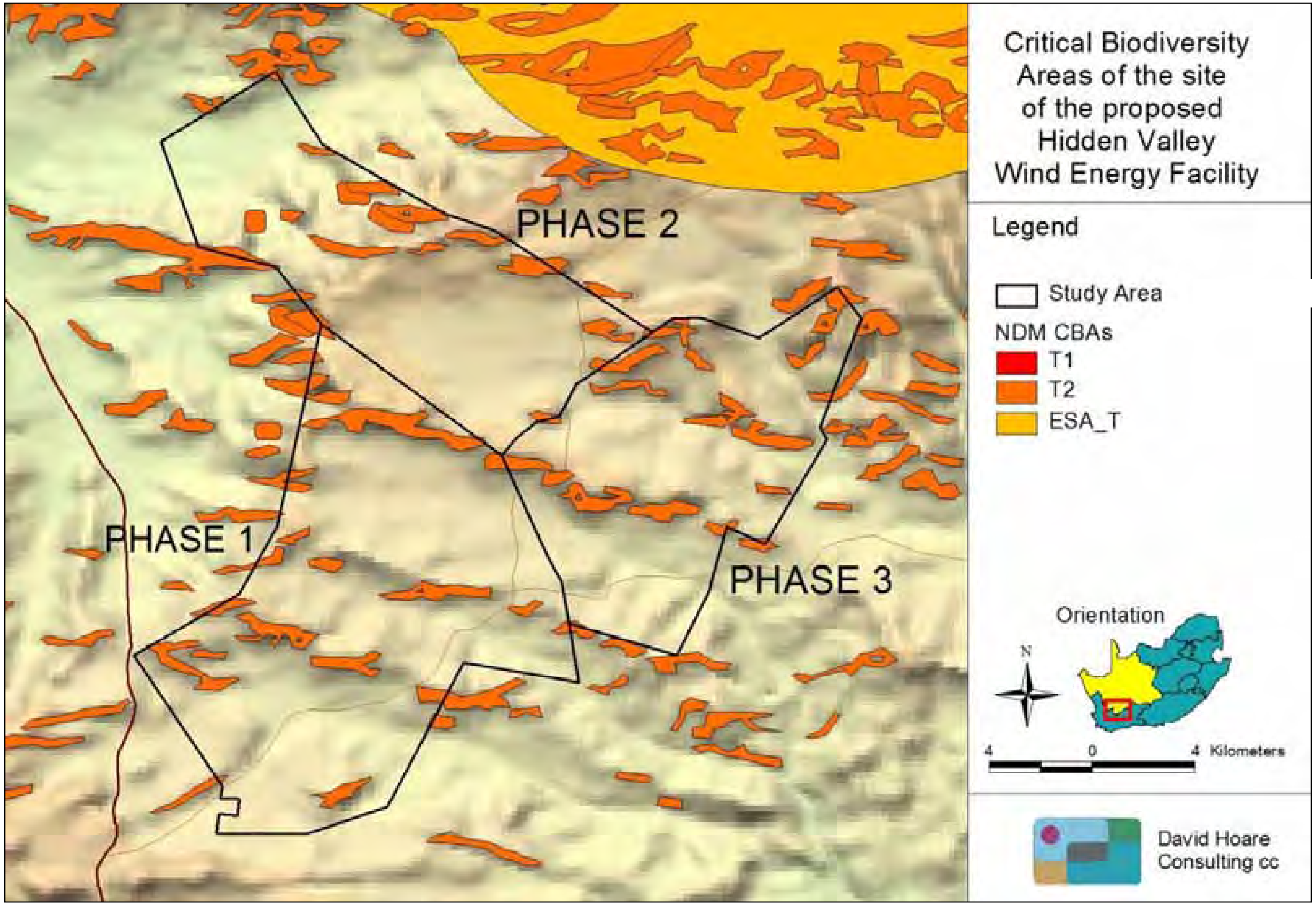

Figure 6.6: Critical Biodiversity Areas (as extracted from the Namakwa District Biodiversity Sector Plan)

6.6.2 Hantam-Roggeveld Centre of Endemism

The majority of the Great Karoo Wind Farm and Soetwater Wind Farm falls within the southern part of the Hantam-Roggeveld Centre of Plant Endemism (HRC), and is illustrated in **Figure 6.7** (van Wyk & Smith 2001). This HRC area occupies the high-lying far south-western corner of the inland plateau of South Africa. The southern and south-eastern boundaries of the HRC (where the study area is located) are demarcated by the Great Escarpment, including the Roggeveld Mountains, Klein Roggeveld Mountains and Besemberg.

The HRC is exceptionally rich in geophytes and petaloid monocots, many of which are endemic to the region. The proportion of these species in the flora of this region is in excess of 30%, which is unparalleled in South Africa and probably in the whole world. The area is a centre of diversity and endemism for a number of plant groups, including *Hesperantha* and *Romulea* (*Iridaceae*), as well as *Liliaceae, Scrophulariaceae, Asteraceae* and *Fabaceae*.The vegetation of the HRC is poorly conserved and there is a great need for the establishment of more conservation areas in the region. Priority areas for the establishment of conservation areas are the Komsberg and Roggeveld Mountains and the plateau around Sutherland (van Wyk & Smith 2001).

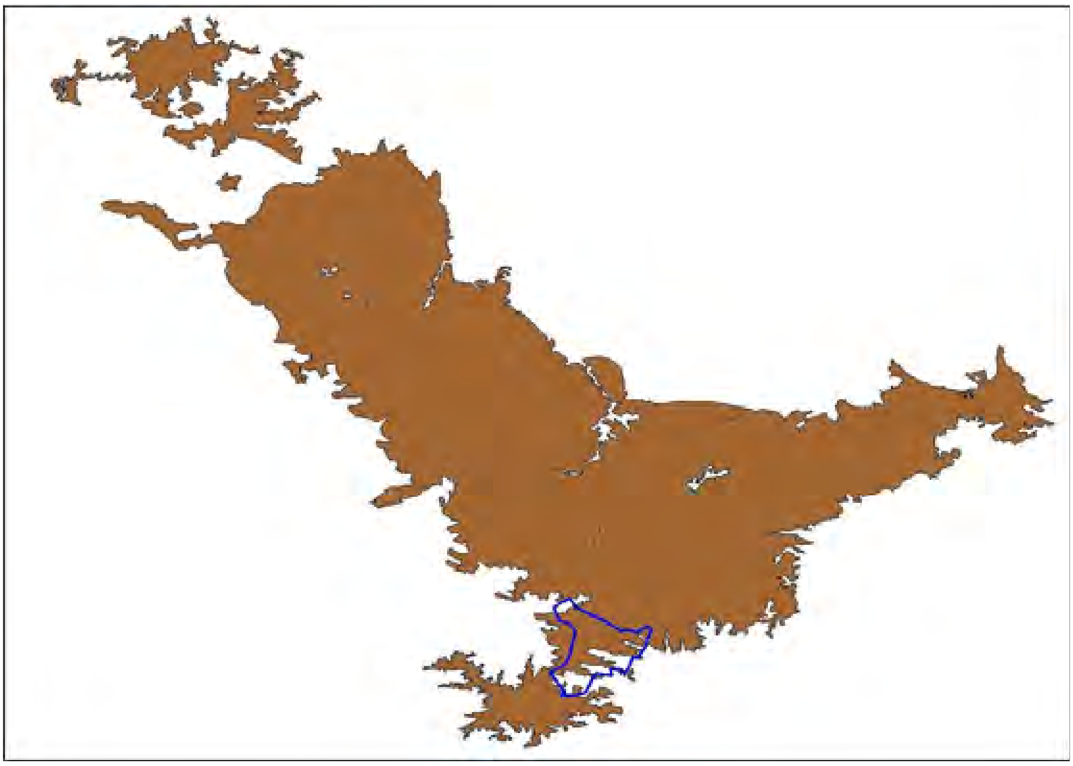

Figure 6.7: Relationship of the Hantam-Roggeveld Centre of Endemism to the full extent of the proposed Hidden Valley wind energy facility site

6.6.2 The Cape Floristic Region

The Karusa Wind Farm site occurs within the Cape Floristic Region (refer to **Figure 6.8**), which is recognised as one of the principal centres of diversity and endemism in Africa (van Wyk & Smith 2001). Moreover, it is one of the earth's 25 hotspots, i.e. geographical areas that contain the world's greatest plant and animal diversity while also being subjected to high levels of pressure from development and/or degradation (Mittermeier *et al*. 2000). The Cape Floristic region is also the only hotspot that encompasses an entire Floristic Kingdom. This region has the greatest extratropical concentration of plant species in the world, with 9000 plant species, 6210 of which are endemics (Cowling & Pierce 2000). Diversity and endemism are high at the generic and familial level as well, with five of South Africa's 12 endemic plant families.

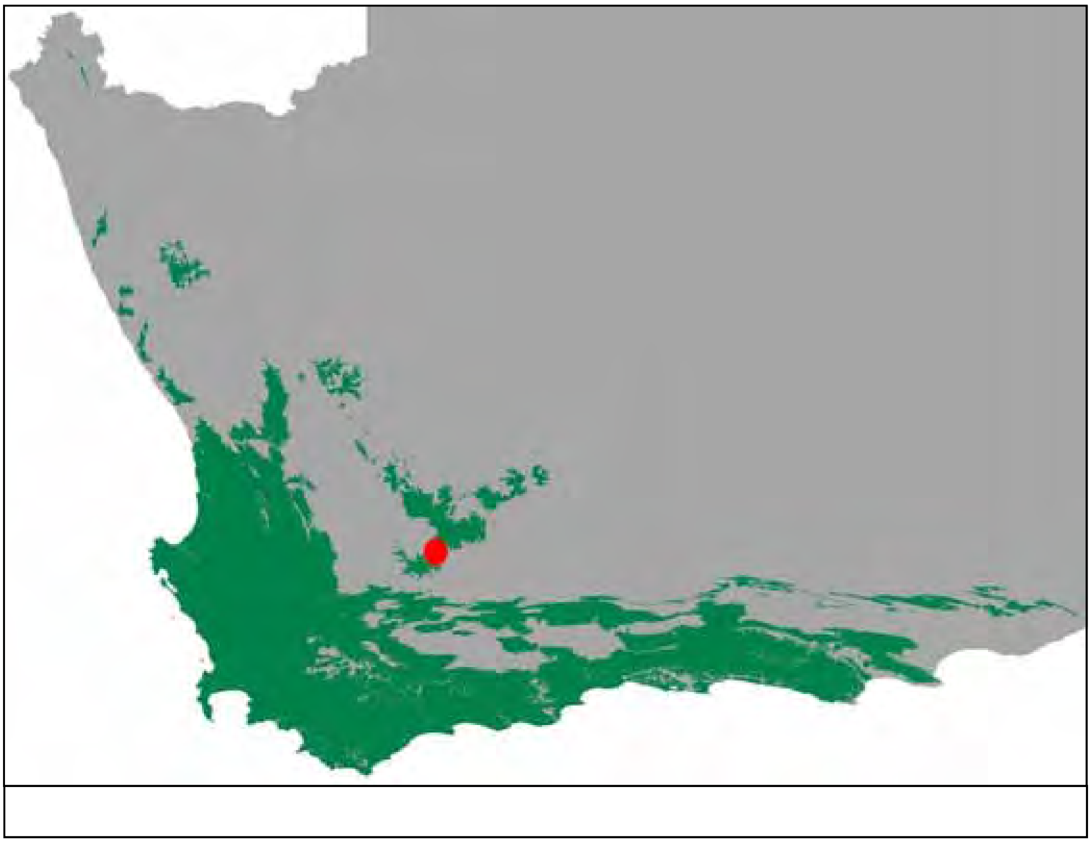

Figure 6.8: Relationship of the Fynbos Biome to the Karusa Wind Farm (red circle).

The characteristic and most widespread vegetation of the Cape Floristic Region (CFR) is fynbos, consisting of hard-leaved, evergreen, fire-prone shrubs. Other vegetation types occurring in the CFR are Renosterveld (which occurs on site), Succulent Karoo (which also occurs on site), Subtropical Thicket and Afromontane Forest, although only Fynbos and Renosterveld are considered to be the main vegetation types in the CFR. Fynbos is associated with the nutrient poor soils of the Cape fold Belt mountains. It is very species rich, with over 75% of the CFR species associated with it, including all the endemic families and most of the endemic genera (van Wyk & Smith 2001). The vegetation type is characterised by a preponderance of *Restionaceae*, *Ericaceae* and *Proteaceae* and a paucity of annuals and grasses. Fynbos is rich in geophytes, notably from the families *Liliaceae*, *Iridaceae* and *Orchidaceae*, and is thought to harbour the richest geophyte flora in the world (Cowling & Richardson 1995). Many different types of Fynbos vegetation are recognised: a total of 78 fynbos and 38 renosterveld vegetation types have been mapped in the recently compiled vegetation map of South Africa (Mucina, Rutherford & Powrie 2005) of a total of 435 vegetation types of the whole country (more than a quarter of the total).

The Fynbos Biome and the CFR are largely concurrent and also match the boundaries of the two main vegetation types found in the Fynbos Biome, fynbos and renosterveld.

Permanent and complete transformation of habitat has affected 33% of the CFR hotspot, which includes parts of the current site. Less than 20% of the total area covered by the CFR hotspot can be considered close to the pristine state in the sense that it is entirely free of alien plants and subjected to appropriate fire and grazing regimes (Cowling & Pierce 2000). The study area is on the edge of this hotspot area near its north-central side and, although the hotspot contains a wide variety of vegetation types, the study area contains one vegetation type of the hotspot.

6.7 Biophysical Characteristics of the Study Area and Surrounds

6.7.1 Soil and Land Types

The land types of the site and broader study area is shown in **Figure 6.9.**

<u>Soils</u>

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991).

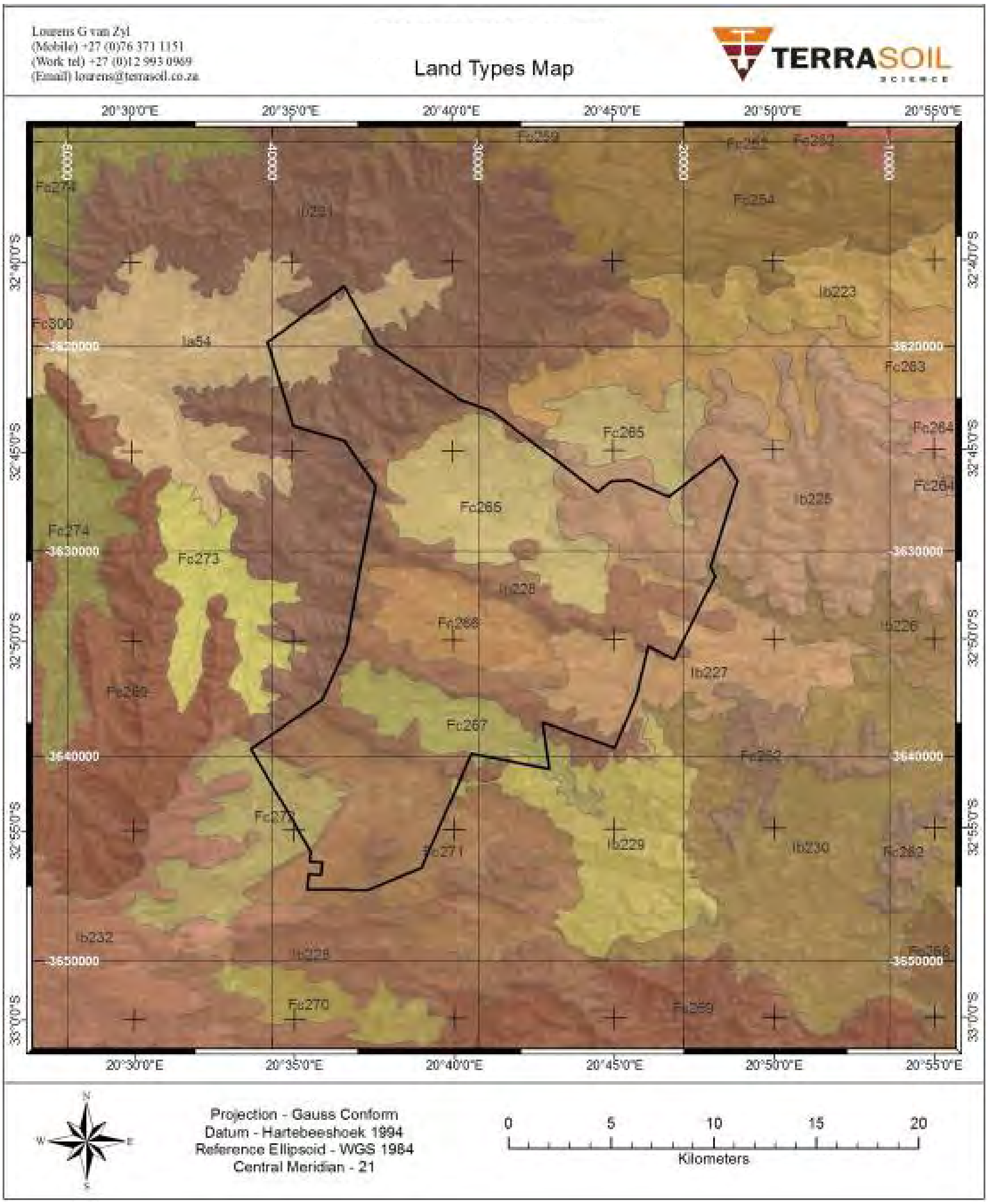

Figure 6.9 Land Type map of the survey site

Land Types

The land types which the three project phases fall into is listed in **Table 6.1**.

Table 6.1: Land types for the three development phases of the project

Project Phase	Landtypes
Phase 1 – Karusa Wind Farm	Fc272; Fc271, Fc267, Ib228; Ib229
Phase 2 – Soetwater Wind Farm	Fc265; Fc266, Ib231; Ia54; Ib228
Phase 3 – Great Karoo Wind Farm	Fc265; Ib228; Ib227; Ib225; Ib226

Figure 6.9 illustrates the land types of the full extent of the site. A brief description of the land types in terms of soils, land capability, land use and agricultural potential is provided below.

Land Types Fc265, Fc266, Fc267, Fc271 and Fc272 (relevant to all three development phases)

This land type occurs at the Soetwater Wind Farm site, parts if the Great Karoo Wind Farm site, and parts of the Karusa Wind Farm site.

» ***Soils:*** Due to the presence of multi-phase terrain units these land types are dominated by shallow soils and rock outcrops in most upland and sloped areas. Localised areas may contain deeper soils with signs of incipient pedogenesis where material has been transported due to colluvial or alluvial processes. In general drainage depressions soils are limited and consist of structured (and often duplex) soils as well as soils with distinct alluvial stratification.
» ***Land capability and land use:*** Exclusively extensive grazing due to climatic, slope and soil constraints. Soil erosion is a distinct risk due to slopes and shallow soils.
» ***Agricultural potential:*** Very low potential due to the low rainfall experienced in the area (less than 200 mm per year), rocky slopes and shallow soils.

Land Type Ia54 (only relevant to the Soetwater Wind Farm)

» ***Soils:*** This land type is dominated by soils with signs of incipient pedogenesis as a result of geologically recent colluvial or alluvial transportation and translocation processes. Rock outcrops and shallow and rocky soils occur as subdominant in this land type.
» ***Land capability and land use:*** Exclusively extensive grazing due to climatic and soil constraints. Soil erosion is a distinct risk due to inherent soil properties of pedologically young soils.
» ***Agricultural potential:*** Very low potential due to the low rainfall experienced in the area (less than 200 mm per year) but potential can be increased through irrigation if water is available.

Land Types Ib225, Ib226, Ib227, Ib228, Ib229, and Ib231 (relevant to the Soetwater Wind Farm site and the Great Karoo Wind Farm only)

» ***Soils:*** Due to the presence of multi-phase terrain units and relatively steep slopes and ridges these land types are dominated almost entirely rock outcrops and localised shallow soils. Deeper soils occur almost exclusively in drainage depressions and then these soils exhibit signs of incipient pedogenesis where material has been transported due to colluvial or alluvial processes. These areas my contain soils that are structured (and often duplex) as well as stratified.

» ***Land capability and land use:*** Exclusively extensive grazing due to climatic, slope and soil constraints. Soil erosion is a distinct risk due to slopes and shallow soils.
» ***Agricultural potential:*** Very low potential due to the low rainfall experienced in the area (less than 200 mm per year), rocky slopes and shallow soils.

6.7.2 Agricultural Potential

The agricultural potential of the entire study site (i.e. including all three development phases) is very low and limited to extensive grazing due to the low rainfall and distinct soil constraints. The soil constraints are centred around the fact that the site is hilly with steep slopes dominating the bulk of the landscape. Under these conditions soils are shallow and rocky and agriculture is, therefore, limited to flat areas in localised floodplains. There is only little potential to increase the agricultural potential in the form of irrigation development as the irrigable soils are very limited in their distribution and extent. Water availability, however, is limited to groundwater (scarce and of variable quality) and occasional surface water contained in dams as a result rainfall events. Much of the study area consists of rock and shallow soils (Glenrosa, Mispah and Cartref) of low potential. The shallower soils are suited for grazing at best. The grazing capacity of the area is moderately low, around 10-14 ha/large stock unit (ARC-ISCW, 2004). The long-term annual average rainfall in the area means that there is a low potential for arable agriculture on the site and study area, unless irrigation is practiced, and few irrigated lands re visible along the rivers in the area.

6.7.3. Vegetation

Vegetation may be described at various hierarchical levels from Biome, to broad Vegetation Type and down to Plant Community level associated with local habitat conditions.
According to this most recent vegetation map of the country (Mucina *et al.*, 2005) the study area falls primarily within four main vegetation types as shown in **Table 6.2**.

Table 6.2: Vegetation types for the three development phases of the project

Project Phase	Main Vegetation Types
Phase 1 – Karusa Wind Farm	» ***Koedoesberge-Moordenaars Karoo*** (falls within the Succulent Karoo Biome) » ***Central Mountain Shale Renosterveld*** (falls within the Fynbos Biome)
Phase 2 – Soetwater Wind Farm	» ***Koedoesberge-Moordenaars Karoo*** (falls within the Succulent Karoo Biome)

	» ***Central Mountain Shale Renosterveld*** (falls within the Fynbos Biome)
Phase 3 – the Great Karoo Wind Farm	» ***Central Mountain Shale Renosterveld*** (falls within the Fynbos Biome) » ***Tanqua Escarpment Shrubland*** (falls within the Succulent Karoo Biome) » ***Tanqua Wash Riviere*** (falls within the Succulent Karoo Biome)

These vegetation types are discussed in more detail below:

» ***Central Mountain Shale Renosterveld*** is found in the Northern Cape and Western Cape on the southern and south-eastern slopes of the Klein Roggeveldberge and Komsberg below the Roggeveld section of the Great Escarpment as well as further east below Besemgoedberg and Suurkop west of Merweville (Rebelo et al. 2006). This landscape consists of slopes and broad ridges of low mountains and escarpments. The vegetation is a tall shrubland dominated by renosterbos of mainly non-succulent karoo shrubs with a rich geophyte flora in the undergrowth or in more open, wetter or rocky habitats (Rebelo *et al*. 2006). This vegetation type occurs in the southern half of the site under assessment (**i.e. the Soetwater Wind Farm and Great Karoo Wind Farm**) and is the most widespread vegetation on the site.

» ***Koedoesberge-Moordenaars Karoo*** is found in the Northern Cape and Western Cape on the Koedoesberge and Pienaar se Berg low mountain ranges bordering on southern Tanqua Karoo and separated by the Klein Roggeveld Mountains from the Moordenaards Karoo (Mucina et al. 2006). The vegetation type occurs on slightly undulating to hilly landscapes. It is a low succulent scrub dotted by scattered tall shrubs and patches of 'white' grass. The most conspicuous dominant genera are dwarf shrubs of *Pteronia*, *Drosanthemum* and *Galenia* (Mucina et al. 2006). This vegetation type occurs in the south-eastern part of the site under assessment.

» ***Tanqua Escarpment Shrubland*** occurs in the Western Cape in a narrow band on north-west facing slopes of the Klein-Roggeveldberge and on south-west facing slopes of the Roggeveld Escarpment as far north as Bloukrans Pass, south of Calvinia (Mucina et al. 2006). The landscape where this vegetation occurs consists of the steep flanks below the escarpment overlloking a basin. The vegetation is a succulent shrubland of medium height with *Tylecodon* and *Euphorbia mauritanica* prominent and with an undergrowth of both succulent and non-succulent shrubs (Mucina et al. 2006). This vegetation type occurs in the north-western part of the site and along the western boundary (**i.e. the Soetwater Wind Farm and on the boundary of the Karusa Wind Farm**).

» ***Tanqua Wash Riviere*** occurs primarily in the Western Cape, but also, to a smaller extent, in the Northern Cape (Mucina et al. 2006). It is found on the alluvia of the Tankwa and Doring Rivers and sheet-wash plains of their less-important tributaries, embedded within the Tanqua Karoo vegetation type. The landscape consists of deeply incised valleys (sometimes several hundred metres broad) of intermittent rivers. The vegetation is a mosaic of succulent shrublands with Salsola and Lycium alternating with Acacia karroo gallery thickets. The broad sheet-wash plains support sparse vegetation of various Salsola species, often building phytogenic hillocks interrupting the monotonous barren face of a sheet wash (Mucina et al. 2006). In the study area, **this vegetation type is confined to a single narrow band that lies in the extreme north-western part of the proposed Soetwater Wind Farm**.

6.7.3.1 Conservation status of broad vegetation types

The vegetation types of South Africa have been categorised according to their conservation status which is, in turn, assessed according to degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these thresholds are as depicted in **Table 6.3**, as determined by best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

The Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the Draft Ecosystem List versus in the scientific literature.

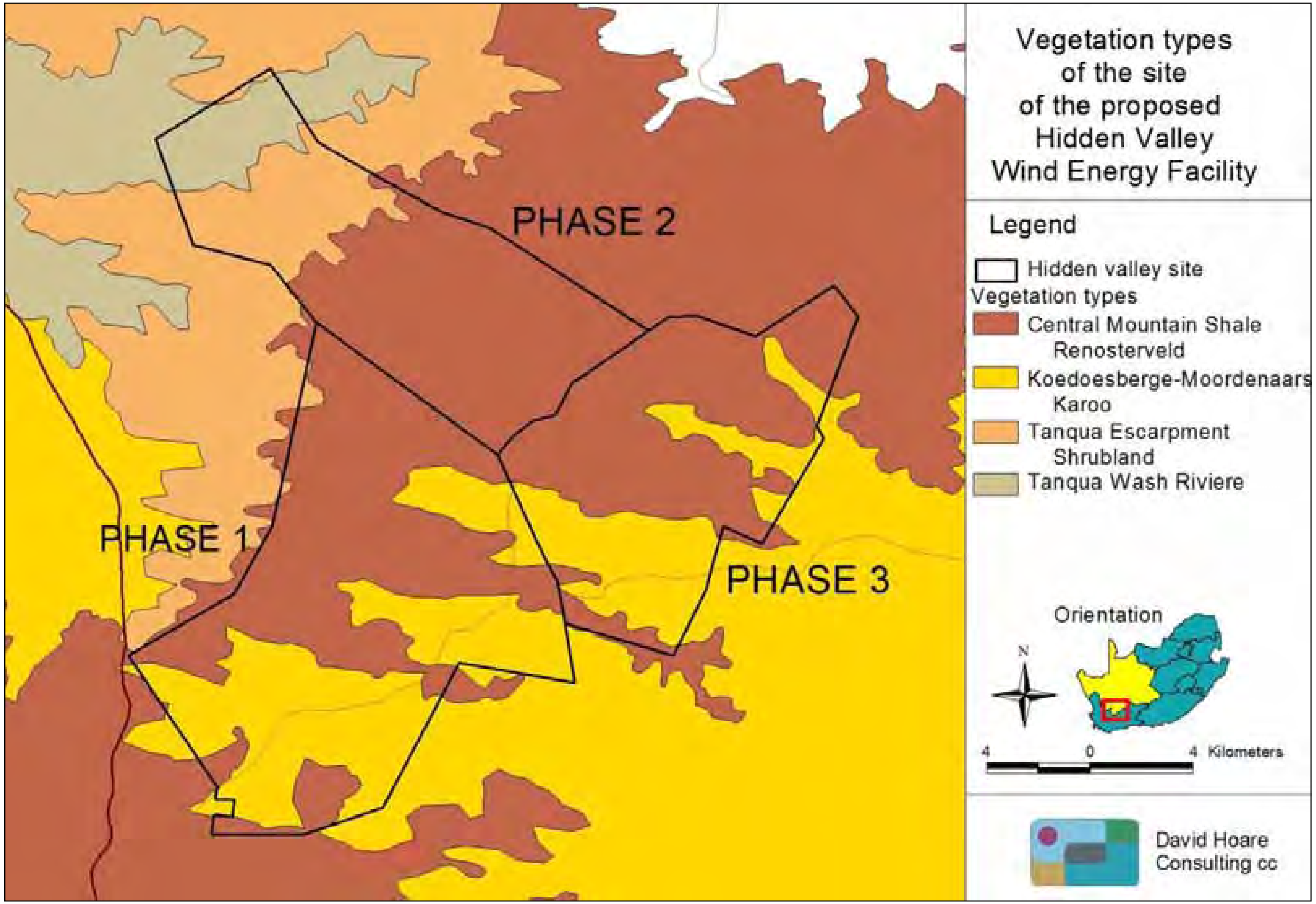

Figure 6.10: Vegetation types of the entire study site and surrounding areas

Table 6.3: Conservation status of different vegetation types occurring in the study area, according to Driver *et al*. 2005 and Mucina *et al*. 2005

Vegetation Type	**Target (%)**	**Conserved (%)**	**Transformed (%)**	**Conservation status**	
				Driver *et al.* 2005; Mucina *et al.*, 2006	**Draft Ecosystem List (NEMBA)**
Central Mountain Shale Renosterveld	27	0	1	Least Threatened	Not listed
Koedoesberge-Moordenaars Karoo	19	0	1	Least Threatened	Not listed
Tanqua Escarpment Shrubland	19	1	0	Least Threatened	Not listed
Tanqua Wash Riviere	19	9	3	Least Threatened	Not listed

Table 6.4: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

6.7.4 Plant communities

There is a published detailed description of the plant communities of this area, based on floristic analysis of field data (van der Merwe *et al*. 2008a, b). The published descriptions separate the general region around the study area into Fynbos and Succulent Karoo-related vegetation with various plant communities described for each. Within the study area are two plant communities described in the publications. A map of the plant communities is shown in **Figure 6.11**. The plant communities' relevant to each development phases are listed under **Table 6.4.** The detailed descriptions provided in the publication (van der Merwe et al. 2008a, b) are useful in that they provide a detailed indication of expected species composition and richness at a local scale, which is not the case with the general vegetation descriptions from the national vegetation map (Mucina et al 2006).

Table 6.4: Plant communities for the three development phases of the project

Project Phase	Plant Communities
Phase 1 – Karusa Wind Farm	» *Oedera genistifolia-Dicerothamnus rhinocerotis* Mountain Renosterveld, occurring on Beaufort Group mudstones of the Klein Roggeveld Mountains. In distribution, this is equivalent to the combination of Central Mountain Shale Renosterveld and Koedoesberge-Moordenaars Karoo within the study area.
Phase 2 – Soetwater Wind Farm	» *Oedera genistifolia-Dicerothamnus rhinocerotis* (Mountain Renosterveld) » *Montina caryophyllacea-Pteronia glauca* Roggeveld Escarpment Karoo, occurring on the Roggeveld Escarpment. In distribution, this is equivalent to Tanqua Escarpment Shrubland within the study area. » *Galenia africana-Pteronia glauca* Escarpment Karoo, occurring on the slopes of the Hantam Mountain, the undulating slopes of the escarpment in the Platberg and surrounding areas south-west of Calvinia, and the slopes where the Roggeveld and Klein Roggeveld Mountains meet. In distribution, this is equivalent to Tanqua Wash Riviere within the study area.
Phase 3 – the Great Karoo Wind Farm	» *Oedera genistifolia-Dicerothamnus rhinocerotis* (Mountain Renosterveld)

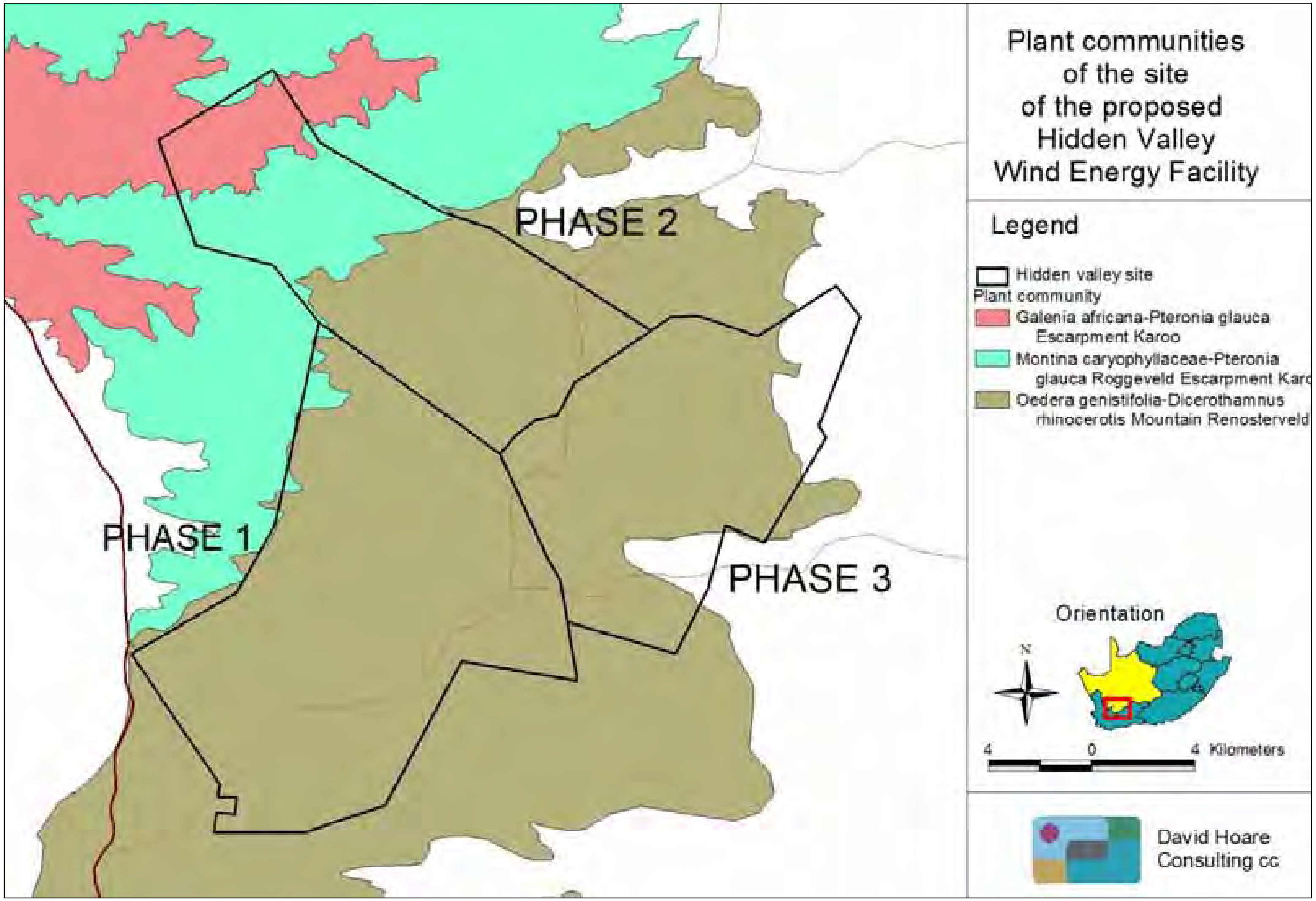

Figure 6.11: Plant communities that occur on the site (Phase 1 – Phase 3)

6.7.5 Red List plant species

Lists of plant species previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1 of the ecology report (Appendix F). Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids are also listed.

The species on this list were evaluated to determine the likelihood of any of them occurring on site. Of the species that are considered to occur within the geographical area under consideration, there were five species recorded in the quarter degree grid in which the study area is located that are listed on the Red List that could occur in habitats that are available in the study area. According to IUCN Ver. 3.1 (IUCN, 2001) three of these are listed as Vulnerable (*Romulea eburnea*, *Lotononis venosa* and *Geissorhiza karooica*) and two as Rare (*Cleretum lyratifolium* and *Strumaria karooica*) (see **Table 6.5** below for explanation of categories). All three species listed as Vulnerable are highly likely to occur on site and have been previously recorded on the site.

Table 6.5: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Data Deficient
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient
LC	Least Concern	Least Concern

6.7.6 Protected trees

There are no tree species protected under the National Forest Act that has been recorded on the site / broader study area.

6.7.7 Red List animal species

All Red List vertebrates (mammals, reptiles, amphibians, birds) that could occur in the study area are listed in Appendix 2 of the Ecology Report (Appendix F). Those vertebrate species with a geographical distribution that includes the study area and habitat preference that includes habitats available in the study area are discussed further. There are three mammal species of conservation concern that have a distribution that coincides with the study area and that have a possibility of occurring on site as a result of habitats available:

- Leseuer's Wing-gland Bat
- the Honey Badger
- Riverine Rabbit.

The Riverine Rabbit is listed as Critically Endangered. The other three species are all listed as Least Concern globally and Near Threatened in South Africa. The overall distribution of the Riverine Rabbit is to the north of the study area, mostly in the plateau areas inland of the escarpment. The species occurs in riverine vegetation on alluvial soils adjacent to seasonal rivers. The red river network is areas designated in the Namakwa District Biodiversity Sector Plan as being habitat suitable for the Riverine Rabbit. The broader site is therefore within the overall distribution range of the species, but habitats on site are probably not suitable for this species. The species is found in dense riverine scrub on deep alluvial soils adjacent to seasonal rivers. There are very few habitats of this description on site that have not been cultivated.

There are two reptile and no amphibian species of conservation concern that have a distribution that includes the study area and which could occur on site. The two reptile species are the Armadillo Girdled Lizard (Vulnerable) and the Namaqua Plated Lizard (Near Threatened). In both cases, the site is at the edge of their distribution range. There is, therefore, a possibility that they could occur on site, but not a high likelihood.

Figure 6.12: Most arable lands in the study area are grazed upon by livestock (see background). A foraging Bat-eared Fox (foreground) was also observed here

6.7.8 Bats

In order to characterise the bat community (obtain baseline data) a pre-construction bat monitoring programme was undertaken at the Hidden Valley Wind Energy Facility site by Animalia cc. The findings from the baseline bat monitoring programme has been included here to comprehensively describe the bat species utilising the site.

6.7.8.1 Habitat for bats on the site

Three factors need to be present for most South African bats to be prevalent in an area:
(1) availability of roosting space;
(2) food (insects/arthropods or fruit); and
(3) accessible open water sources.

The dependence of a bat on each of these factors also depends on the species, its behaviour and ecology. Nevertheless, bat activity, abundance and diversity are likely to be higher in areas/ habitat supporting all three above mentioned factors. The importance of the vegetation units and associated geomorphology serving as potential roosting sites have been described in Table 6.6. No bat roosts were found on site.

Table 6.6: Potential of the vegetation to serve as suitable roosting and foraging spaces for bats

Vegetation Unit	**Roosting Potential**	**Foraging Potential**	**Comments**	**Relevant Phase**
Central Mountain Shale Renosterveld	Low	Moderate	This sparsely vegetated unit provides low foraging potential to open space foragers. Also the low agricultural potential of the unit provides less attraction to bats for foraging purposes.	» Phase 1 – Karusa Wind Farm » Phase 2 – Soetwater Wind Farm » Phase 3 – Great Karoo Wind Farm
Koedoesberge-Moordenaars Karoo	Moderate	Moderate	The grass vegetation can provide moderate feeding potential while the buildings in the area can provide roosting sites	» Phase 1 – Karusa Wind Farm » Phase 2 – Soetwater Wind Farm
Tanqua Escarpment Shrubland	Moderate - High	High	The succulent plants may attract insects and thus bats for foraging. This unit is found in basins and can provide foraging potential	» Phase 3 – Great Karoo Wind Farm

6.7.8.2 Bat species confirming during monitoring

There are three bat species (one species considered as "near threatened" (the Natal long-fingered bat) and two considered as species of "least concern" (the Cape Serotine bat and the Egyptian Free-tailed bat) which were recorded at the proposed Hidden Valley wind energy facility site. These species are of importance based on their potential abundance in the area and therefore their high contribution to ecological functions, the Natal long-fingered bat (*M. natalensis*) appeared to be less abundant, but is a migratory species. The species are discussed in more detail below:

» ***Miniopterus natalensis:*** Also commonly referred to as the Natal long-fingered bat. This species occurs widely across South Africa and is listed as Near Threatened (Monadjem *et al*., 2010). This bat is a cave-dependent species, although culverts and mines have also been observed as roosting sites for either single bats or small colonies. Separate roosting sites are used for winter hibernation activities and summer maternity behaviour, with the winter hibernacula generally occurring at higher altitudes in more temperate areas, and the summer hibernacula occurring at lower altitudes in warmer areas of the country (Monadjem *et al*., 2010). Mating and fertilisation usually occur during

March and April and is followed by a period of delayed implantation until July/August. Birth of a single pup usually occurs between October and December as the females congregate at maternity roosts (Monadjem *et al,* 2010 & Van Der Merwe, 1979). The Natal long-fingered bat undertakes short migratory journeys between hibernaculum and maternity roosts. The mass movement of bats during migratory periods could result in mass casualties if wind turbines are positioned over a mass migratory route. Very little is known about the migratory behaviour and paths of *M. natalensis* in South Africa with migration distances exceeding 150 kilometres.

» ***Neoromicia capensis:*** Commonly called the Cape Serotine bat, *Neoromicia capensis* has a Least Concern conservation status as it is widespread over much of sub-Saharan Africa in high numbers. *Neoromicia capensis* was abundant and widespread on the site. By virtue of their sheer abundance, this species has a more significant role to play within the local ecosystem than other rarer bat species. They do not undertake migrations and are therefore considered residents on the Hidden Valley site. It roosts individually or in small groups of two or three bats in a variety of shelters, such as under the bark of trees, at the base of aloe leaves, and under the roofs of houses. They will use most man-made structures as day roosts (Monadjem *et al*., 2010). They are tolerant of a wide range of environmental conditions as they survive and prosper within arid semi-desert areas to montane grasslands, forests, and savannas; inferring that they may occupy several habitat types across the site, and are adaptable towards habitat changes. They are, however, clutter-edge foragers, meaning that they prefer to hunt on the edge of vegetation clutter mostly, but that they may occasionally forage in open spaces. Mating takes place from the end of March until the beginning of April. Spermatozoa are stored in the uterine horns of the female from April until August, when ovulation and fertilisation occurs. They typically give birth to twins during late October and November, although singletons, triplets and even quadruplets have been recorded (Lynch, 1989).

» ***Tadarida aegyptiaca:*** The Egyptian Free-tailed bat, *Tadarida aegyptiaca*, is a Least Concern species as it has a wide distribution and high abundance throughout South Africa. It occurs from the Western Cape of South Africa, north through to Namibia and southern Angola; and through Zimbabwe to central and northern Mozambique (Monadjem *et al*., 2010). This species is protected by national legislation in South Africa (ACR, 2010). They roost communally in small (dozens) to medium-sized (hundreds) groups in caves, rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. *Tadarida aegyptiaca* has also adapted to roosting in buildings, in particular roofs of houses (Monadjem *et al*., 2010). Man-made structure and large trees on the site would be important roosts for this species. *Tadarida* *aegyptiaca* forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem *et al*., 2010). Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause of concern as these species have more significant ecological roles than the rarer bat species, by virtue of their sheer abundance. The bat sensitivity maps contained in the monitoring report influenced by the areas that may be used by this species. After a gestation of four months, a single young is born, usually in November or December in maternity colonies established by females.

The bat monitoring study found that localised bat activity at certain times of the year occurred within the wind energy facility site.

6.7.9 Avifauna

In order to characterise the birds (baseline) a pre-construction bird monitoring programme was undertaken at the Hidden Valley Wind Energy Facility site and at a control site. The findings from observations through the bird monitoring programme have been incorporated into this section, supplementary to the avifaunal impact assessment (EWT, February 2012).

6.7.9.1 Avifauna Habitat

From an examination of the sites vegetation types, it can be expected that bird species favouring Karoo and Fynbos type vegetation are expected on the site. These are species that favour short, “shrubland” type vegetation such as Korhaans, Larks, Pipits, Prinia and Bustards. The following avifaunal microhabitats were identified across the full extent of the site and broader study area and occur on three phases of development:

- Cultivated Lands
- Shrublands
- Dams
- Rivers
- Hills and ridges
- Thicket

The above vegetation description partially describes the species likely to occur in the study area. However, more detail is required in order to understand exactly where within the study (and is relevant to all phases of development) certain species will occur. These "micro" habitats are formed by a combination of factors such as vegetation, land use, and others. These micro habitats will be critically important in siting the proposed turbines within the affected farms. The following micro habitats were identified in the study area (confirmed through a site visit by an avifauna specialist):

» **Rivers or streams and drainage lines:** A number of small rivers and streams as well as drainage lines bisect the affected farms. In the study area although many of these water courses seldom contain water, these systems are important, as they have a different vegetation composition to the remainder of the plains, often including woody species such as *Acacia Karoo.* Wooded riparian habitat along rivers may provide habitat for various species such as the Hamerkop, African Darter, various cormorants, kingfishers, bee-eaters, robin-chats and numerous smaller species. Rivers also represent feeding areas for fish eating raptors such as the African Fish Eagle. Black Storks favour watercourses, as do Geese and Ibises. Furthermore any river, stream or drainage line represents an important flight path for many bird species.

Figure 6.13: One of the flowing streams observed on site

» **Arable or cultivated land:** Arable or cultivated land represents a significant feeding area for many bird species in any landscape for the following reasons:

through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources readily accessible to birds and other predators; the crop or pasture plants cultivated are often eaten themselves by birds, or attract insects which are in turn eaten by birds; during the dry season arable lands often represent the only green or attractive food sources in an otherwise dry landscape. Arable lands exist sparsely in this study area, predominantly along watercourses, and areas planted as pasture for livestock grazing. Relevant bird species that may be attracted to these areas may include Ludwig's Bustard and White Stork. In particular the White Stork has a high affinity with arable lands, with 86% of sightings in South Africa recorded on arable lands. Although not recorded in the data sets examined, the presence of this protected species in the study area is possible, especially in the summertime.

» **Dams:** Various waterfowl, such as Spur-winged geese, South African Shelduck, Egyptian geese, and numerous duck species, may frequent dam sites. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall, such as darters and cormorants. Flamingos, which often fly at dusk and dawn in low light conditions, may use larger shallow dams and other wetland areas when moving through the landscape. Therefore dams are a key element of this study. During the site visit, a Black Stork was observed at one of the larger dams in the study area.

Figure 6.14: A large dam in the study area

Figure 6.15: Farm dam (note Hadeda Ibises flying above).

» **Thickets and Woodland:** Narrow strips of thicket exist in the study area and are associated with rivers, streams and drainage lines, as well as on the slopes of some hills. While the river valleys and drainage lines (with water present), may attract numerous species due to the presence of water, the thicket areas themselves are important to physically smaller bird species such as Robin-chats, Scrub-Robins, Warblers, Prinia, Doves and Bulbuls.

Figure 6.16: Thicket areas observed in a drainage line on site.

» **Hills and Ridges:** There are hilly/mountainous areas in the study area, particularly in the north. Ridges represent important habitat for a number of species. Most relevant to this study are the aerial species such as raptors and swifts/swallows – which favour flying along ridges where there are favorable air currents. Raptors in particular will be prevalent along pronounced ridges and are likely to hunt along the ridge edge, which results in them being distracted by potential prey, thereby making them more vulnerable to collision with vertical structures such as wind turbines. Ridges are present along rivers and streams, where in some instances cliff faces (refer to **Figure 6.17**) have been created.

Figure 6.17: A ridge and cliff area observed on site.

» **"Karoo" and/or "Fynbos" Shrublands:** These are vast open areas of relatively low "shrub-like" vegetation. This is the predominant Micro-habitat within the vegetation types of "Central Mountain Shale Renosterveld" and "Koedoesberge-Moordenaars Karoo". These areas may be frequented by Karoo Korhaan, Southern Black Korhaan, and Ludwig's Bustard. Raptors such as Southern Pale Chanting Goshawk, Jackal Buzzard, Martial Eagle, Rock Kestrel and Lesser Kestrel, may hunt in these areas. Smaller passerines such as Larks, Pipits, Chats, Robin-Chats and Prinia also occur. Small short grassy and rocky patches are found within the shrublands, and attract species such as Ant-eating Chat, Guineafowl and Spurfowl.

Figure 6.18 Open "Shrublands" occurring acoss the site

Figure 6.19: Short grassy and rocky, open areas.

6.7.9.2 Bird presence in the study area

a) *Species occurring in the area at significant abundances*

Species that have been recorded in abundances on the site within altered habitats (e.g. pastures and cultivated lands) include: Blacksmith Lapwing, Cape Wagtail, Cape Sparrow, Egyptian Goose, South African Shelduck, and Spur-winged Goose. The majority of observations however were in natural vegetation such as "shrublands" and karoo scrub where species that have been recorded in abundances include: Ant-eating Chat, Bokmakierie, Cape Clapper Lark, Cape Bunting, Cape Weaver, Grey-backed Cisticola, Karoo Prinia, Large-billed Lark, Karoo Scrub-robin, White-throated Canary and Yellow Canary. The small terrestrial species that were recorded during the walk transects over the survey period are not threatened or restricted in range. The bird monitoring report (Appendix R) provides a full list all the species recorded on the site.

b) Groups of species which could possibly be impacted on by wind farms

The taxonomic groups that have been found to be vulnerable in two or more of these regions are as follows: Pelicaniformes (pelicans, gannets, cormorants); Ciconiiformes (storks, herons, ibises, spoonbills); Anseriformes (swans, ducks, geese); Falconiformes (birds of prey); Charadriiformes (gulls, terns, waders); Strigiformes (owls); Caprimulgiformes (nightjars); Gruiformes (cranes, bustards, rails); Galliformes (pheasants, grouse, francolins); and Passeriformes (songbirds).

c) Red Listed Bird Species

A total of 149 different species were recorded on the proposed site during the pre-construction bird monitoring programme. Seven recorded bird species are Red Listed (Barnes, 2000), with three classified as Vulnerable (Ludwig's Bustard, Martial Eagle and Blue Crane) and four as Near-threatened (Black Harrier, Lanner Falcon, Black Stork and Karoo Lark).

Of these species, the raptors, Black Stork and Ludwig's Bustard are of most concern, not only in terms of collision with turbines, but also the less direct impact resulting from the wind farm clusters forming barriers to the bird's movement within this area (i.e. habitat disturbance). The proposed positioning of the turbines, along ridges and at the top of hills, here and in wind farms more generally, places a larger threat on hovering and soaring raptors.

6.7.9.3 Target / Priority Bird Species

Sixteen (16) priority bird species were identified on the site including:

» African Harrier-hawk
» Amur Falcon
» Black-shouldered Kite
» Blue Crane
» Booted Eagle
» Gabar Goshawk
» Jackal Buzzard
» Lanner Falcon

» Ludwig's Bustard
» Martial Eagle
» Rock Kestrel
» S. Pale Chanting Goshawk
» Southern Black Korhaan
» Steppe Buzzard
» Verreauxs' Eagle
» Yellow-billed Kite

Of the 16 priority species recorded on the drive transects, the Southern Pale Chanting Goshawk, Southern Black Korhaan, Rock Kestrel and Jackal Buzzard were observed across all seasons, and these species were most abundant.

6.7.9.3 Other Key Findings of the Bird Monitoring

» No less than five separate individual Martial Eagles across the entire site, including an unusual observation of four individual adults soaring in one location, and one juvenile in another location which allows 100% certainty of five Martial Eagles. There is a suspected Martial Eagle nest; however the actual position could not be confirmed.
» At least three Verreaux’s Eagles, two adults and a juvenile, were recorded utilising the study site, although a nest site was not located.
» The observers were able to distinguish between two primary types of flight used by Martial and Verreaux’s Eagles on the site, firstly ridge and slope soaring on windy days and secondly, thermal soaring and gliding on still warm days. Thermal soaring occurred in valleys and then the eagles glided to slopes and ridges.
» A third flight mode was also observed, namely flapping on calm days early in the morning before thermals had developed. This flight was seen to be lower and slower. This behaviour confirms the recommendation for turbines to be set back slightly from the ridge line as these birds are using these areas during windy conditions.

6.8 Social Characteristics of the Study Area and Surrounds

6.8.1 Administrative Context

The proposed Hidden Valley Wind Energy Facility is located in the Karoo Hoogland Local Municipality, of the Northern Cape Province. However, the site borders on the Laingsburg Local Municipality to the south, which is located in the Western Cape Province.

The Karoo Hoogland LM (NC066) is one of seven B-Municipalities comprising the Namakwa District Municipality (NDM) (DC6). The administrative seat of the Karoo Hoogland LM is split between the towns of Sutherland, Williston and Fraserburg; that of the Namakwa DM in Springbok. The Namakwa DM is comprised of a very extensive area. Sutherland is located approximately 539 km from Springbok. The Karoo Hoogland LM measures approximately 34 038 km² in extent. Urban settlement is essentially limited to the towns of Sutherland, Williston and Fraserburg, with large distances separating the three from one another. The Municipality is comprised of 4 Wards. All three phases of the project falls within Ward 4 (Sutherland/ Roggeveld rural area), which measures approximately 9 264 km² in extent.

6.8.2 Socio-Economic Context

Presentation in this section is on a Local Municipality-wide level, and based on data from the last Census count (Census 2001). Labour-unintensive stock farming operations on extensive farming units has traditionally characterised land use in the study area Municipalities. As a result, a tendency towards the concentration of population (in relative as well as absolute terms) in Laingsburg and Sutherland, respectively, exists. Laingsburg's location in proximity to the real or imagined economic opportunities associated with people movement along the N1 has been specifically significant. This situation of urban concentration (and rural depopulation) has over the past decade or so gained significant momentum as a result of significant labour shedding by the agricultural sector in the wake of Extension of Security and Tenure Act (ESTA) legislation[9]. This has also resulted in

[9] Extension of Security of Tenure Act (Act 62 of 1997). While the intention of the Act was to ensure that farm labourer families had access to continued tenure on farms independently of whether family members were still employed on the farm (dependent on the qualification of having worked and resided on the farm for a specified number of years), in practice the implementation of the Act lead to massive loss of tenure to farm workers not meeting the qualification. The resettlement of farm labour was coupled to the trend towards rationalisation of labour practices in the agricultural sector. Urbanised farm workers are generally unprepared to compete in the semi-skilled and skilled urban job markets, and consequently unemployment and poverty levels are very high amongst these urban newcomers.

an increasing shift away from traditional stock farming to even less labour-intensive game farming.

With regard to the Ward 4 area of the Karoo Hoogland LM (an area comparable in size to the Laingsburg LM), approximately 54% of the total population (3 648) was estimated to live in the town of Sutherland (approximately 50 km north west of the proposed facility site) in 2001. It is assumed that a similar trend of increased urban concentration would have occurred with regard to Sutherland since 2001.

a) **Population**

According to Census 2001 data, the total population of the Karoo Hoogland LM 10 513. More recent data for the Laingsburg LM estimated a 2006 population of around 7 330. More recent figures for Karoo Hoogland could not be sourced.

Table 6.7: Population for Laingsburg and Karoo Hoogland Municipalities

Population Group	**Karoo Hoogland LM**	
	Number	**%**
Black African	325	3
Coloured	8 321	79
Indian or Asian	18	-
White	1 849	18
Total	10 513	100

Source: Census 2001

As may be seen in **Table 6.7** above, in 2001 the Coloured population made up the majority of the Karoo Hoogland (79%) LM. The White group was second, namely 15.5% and 18%, respectively. Census 2001 further indicated that the overwhelming majority of the relevant populations, namely 98% and 98.5%, spoke Afrikaans as first language respectively. The scarcity of economic opportunities (and therefore limited appeal to economic in-migrants) is likely responsible for only small percentages of the Black group (viz. 2% and 3%, respectively) recorded in 2001. It is assumed that this situation would have remained more or less unchanged since 2001.

b) **Age distribution**

Data presented in **Table 6.8** below indicates age profiles for the population groups, namely around 29% youthful dependents (<15 age group); around 62% working age people (15-64), and a formally retired group comprising 8-9% (>65). The IDP documents for the Karoo Hoogland LM indicate that economically-motivated out-migration is an established trend.

Table 6.8: Age distribution for study area communities

Age Group	Karoo Hoogland LM %
0-4	10
5-9	10
10-14	9.5
[Youthful dependents]	[29.5]
15-19	7.5
20-24	6
25-29	7
30-34	8
35-39	7.5
40-44	6.5
45-49	6
50-54	5
55-59	4
60-64	4
[Working age]	[61.5]
65-69	3
70-74	2
75-79	2
80 and over	2

Source: Census 2001

c) Education levels

As indicated in **Table 6.9**, general education levels are low. Therefore, according to Census data, approximately 43% 48% of the population of Karoo Hoogland aged 20 and older was estimated to be functionally illiterate/ innumerate in 2001. High adult illiteracy levels have been identified as a critical issue in the Karoo Hoogland IDP of Reskilling of people with only basic primary (agricultural labour) skills has been identified as a significant priority.

Table 6.9: Education levels for the study area (population 20 and older)

Description	**Karoo Hoogland LM %**
No schooling	28
Some primary	20
[% functional illiteracy/ innumeracy][10]	[48]

[10] In the South African context, having obtained a primary qualification (i.e. having successfully passed Grade 7) is generally held as the absolute minimum requirement for functional literacy/ numeracy. The National Department of Education's ABET (Adult Basic Education and Training) programme provides

Complete primary	7
Some secondary	23
Std 10/Grade 12	14
Higher	8

Source: Census 2001

d) Employment levels

The employment statistics presented in **Table 6.10** indicate that in 2001 46.5% of the Laingsburg LM population was employed, and 45 % of that of Karoo Hoogland LM. Unemployment rates for both communities were comparable with the 2001 provincial average (17%), viz. 16.5% and 18%, respectively. Economic non-participation rates for both communities were also high, at around 37%. This is specifically relevant as no indigenous student population is associated with the working age populations of either municipality. Judging from the status quo analyses presented in the relevant IDP documents it also appears likely that the unemployment rates recorded in 2001 masked significant underemployment and/ or seasonal unemployment. Unemployment rates are also assumed to have increased since 2001 as a result of labour shedding by the agricultural sector.

Table 6.10: Study area communities employment levels (15 – 64 age group) *Source: Census 2001*

Description	Laingsburg LM %	Karoo Hoogland LM %
Employed[11]	46.5	45
Unemployed	16.5	18
Not Economically Active[12]	37	37

Household income

Poverty levels in both study area populations are extremely high, and poverty widespread. Census data for 2001, presented in **Table 6.11** below, indicated that 64.5% of households in the Laingsburg LM and 70% of those in the Karoo Hoogland LM were living below the minimum subsistence level (pegged at R1600/ m in 2001). Around 50% of each of the communities was clustered in the R400-R1600 income category.

education and training up to the equivalent of Grade 9. In this more onerous definition, Grade 9 is required as the minimum qualification for having obtained a basic education (www.abet.co.za).

[11] Census 2001 official definition of *an unemployed person*: "A person between the ages of 15 and 65 with responses as follows: 'No, did not have work'; 'Could not find work'; 'Have taken active steps to find employment'; 'Could start within one week, if offered work'." (www.statssa.gov.za).

[12] The term "not economically active" refers to people of working age not actively participating in the economy, such as early retirees, students, the disabled and home-makers.

Table 6.11: Study area communities income (by head of household)

Income per month	Laingsburg LM %	Karoo Hoogland LM %
No formal income	5.5	10
R 1 – R 400	9	11.5
R 401 – R 800	23	25
R 801 - R 1 600	27	23.5
[% households below minimum subsistence level]	[64.5]	[70]
R1 601 - R 3 200	19	13.5
R 3 201 – R 6 400	9	7
R 6 401 – R 12 800	5	5.5
R 12 801 – R 25 600	2	2
R 25 601 and higher	0.5	2

Source: Census 2001

Sectoral employment

Table 6.12 below provides an overview of proportional employment per economic sector for the labour forces of both relevant populations. In this regard, the data shows that the agricultural sector was the main provider of employment opportunities, namely 47% for the Laingsburg LM, and 49% for the Karoo Hoogland LM. Low contributions by the Manufacturing sector indicate that very little processing of agricultural produce takes place locally. The relative importance of the Wholesale and retail trade (19%) in the Laingsburg LM is in part associated with people flows associated with the N1. Community, social and personal services sector were important in both municipalities, and are likely to be related to employment opportunities associated with local government.

Table 6.12: Sectoral contribution to employment

Description	Laingsburg LM %	Karoo Hoogland LM %
Agriculture, hunting, forestry and fishing	47	49
Mining and quarrying	-	-
Manufacturing	3	1.5
Electricity, gas and water supply	0.5	-
Construction	3.5	3.5
Wholesale and retail trade	19	6.5
Transport. Storage and communication	3.5	1.5
Fin., real estate and bus. Services	2.5	3.5
Community, social and personal services	15	16
Other and not adequately defined	-	-

Private households[13]	6	15

Source: Derived from Census 2001

6.9 Heritage Profile

No systematic archaeological research has been conducted within this region of the Northern Cape, therefore little archive material is available for the archaeology of the immediate area proposed for the wind energy facility. What is known is that the wider Karoo landscape has been occupied by humans since the Early Stone Age (ESA), spanning an occupation period of about 1.5 million years. Archaeological evidence is usually observed as surface scatters and is widely dispersed across the landscape. Caves are uncommon in the Karoo and open sites (Early Stone Age to the last 2000 years) generally consist of single-level occupations near sources of water such as rivers, streams and springs. Rock engravings are widespread over the Karoo landscape, substantial research has been conducted within the Northern and Western Cape areas of the Karoo (Parkington et al. 2008). Early travellers and trekboere (Dutch farmers) started entering this part of the Northern Cape towards the end of the 18th century and colonial settlement increased towards the second half of the 19th century.

A field survey was conducted in order to understand the historical archaeological features occurring within the area proposed for the three development phases. These are discussed below.

The NHRA stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

» Grade I: Heritage resources with qualities so exceptional that they are of special national significance;
» Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
» Grade III: Other heritage resources worthy of conservation on a local authority level.

The occurrence of sites with a Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the applicable mitigation measures

[13] This category mainly comprises domestic workers and gardeners.

would allow the development activities to continue. All the sites identified within the area, and listed below have been classified as Grade III sites.

6.9.1: Phase 1: Karusa Wind Farm

a) Graveyard on the Farm Standvastigheid 210

Mixed formal family graves and informal labourers' stone packed burials. The dates of the formal graves with headstones range from the late 1800's until the late 1900's. The fenced/cordoned graveyard is situated adjacent to the farm gravel road within the vicinity of the current farmstead complex.

b) Dry Packed Stone Walling Kraal of the Farm Standvastigheid 210

The dry packed stone walling kraal is situated directly north of the farm gravel road within the vicinity of the current farmstead complex.

c) Dry packed stone walling boundary fences/walls on the Farm Standvastigheid 210

Two dry packed stone walling boundary walls occur on the flat lands north- west and south-east of the current farmstead area. This site is referred to as HVSTSW1, and extends for approximately 1072m and is about 1m in width and 1m in height. The opposite sections of the wall adjacent to the farm gravel road have collapsed, however, the rest of the wall extend west remain relatively intact. The site referred to as HVSTSW, extends for approximately 500m east to the boundary of the neighbouring farm and is about 1m in width and 50cm in height. The wall is situated with the farm boundary fence directly south of the main road that runs through the valley.

d) Farmstead Complex on the Farm De Hoop 202

The stone walling farmstead complex comprises one main cottage and two additional cottages. A mixture of clay/mud has been used as the binding for the packed stones. The complex also includes a dry packed stone walling kraal situated south of the main cottage and stables situated to west. A built-up stone dam and pond also occur within the farmstead complex area.

6.9.2: Phase 2: Soetwater Wind Farm

a) Dry Packed Stone Walling Dwelling on Portion 1 of the Farm Orange Fontein 203

The ruin of a dry packed stone walling dwelling, possibly occupied by shepherds, is situated adjacent to the farm gravel road that leads to the site.

b) Farmstead Complex on Portion 1 of the Farm Orange Fontein 203

The stone walling farmstead complex comprises one main recently renovated or built main house and associated stone walling boundary walls and a sun-dried brick and clay/mud plastered cottage. The cottage is situated on the southern bank of a non-perennial stream. A dry packed stone wall extends east-west to the south of the cottage. A family graveyard is situated west of the cottage. The complex also includes a dry packed stone walling kraal situated west of the graveyard and cottage and stables are situated to the north –east of the kraal. Corrugated iron sheds, possibly still in use, are included within this farmstead complex. An old mill water pump and reservoir are situated along the farm gravel road to the north-west of the main farmstead complex area.

c) Clay Packed Stone Walling Cottage on remainder of Portion 1 of the Farm Orange Fontein 203 (CottageRuins):

The clay packed stone walling cottage is situated to the west of the current main farm house and north of the farm gravel road. It is possible that an additional structure may have been situated next to the cottage by the indication of possible foundations near to the farm gravel road, or it could reflect the distribution of the debris after collapse.

d) Dry Packed Stone Walling Kraal on remainder of Portion 1 of the Farm Orange Fontein 203

A dry packed stone walling kraal is situated on the slight gradient slope of a low hill near the current labourers' cottages. Historically, the kraal was used to house ostriches.

6.9.2: Phase 3: Great Karoo Wind Farm

a) Dry Packed Stone Walling Kraal on the Farm Kentucky 206

A dry packed stone walling kraal is situated within the vicinity of the current farmstead complex. The kraal has been built on the slight gradient slope of a low hill. Several of the walls have collapsed and the kraal is currently not in use. This site is not referenced on map – for discussion purposes.

b) Two Graveyards on the Farm Kentucky 206

A fenced formal family graveyard with two stone packed informal burials is situated about 300m west of the current main farm house. The informal farm labourers' graveyard is situated slightly east of the labourers' cottage about 5m from the edge of a large donga. The burials are all stone packed and contain no formal headstones. The area is also not cordoned off with fencing.

c) <u>Farmstead Complex on the Farm Kentucky 206</u>

The stone walling farmstead complex is situated on the eastern side of a perennial stream in one of the valleys and comprises three clay packed stone walling cottages. The condition of the main cottage is in relatively good condition and the architectural design is still visible. The farmstead complex also includes a stone walling with sufficient space and arrangement for loading, stables in a relatively good condition with troughs still intact and a dry packed stone walling kraal near the ruins of the two cottages within the western half of the farmstead complex area. A general scatter of broken glass and ceramic sherds occur over the general farmstead complex area, however, a denser scatter with possible deposit of historical artefacts and fauna occurs near the two cottages in the western half of the farmstead complex area. A separate dry packed stone walling kraal is situated on the western side of the perennial stream and is still in and maintained to house domestic stock.

6.9 Palaeontology

The site is associated with continuous Permian-age sedimentary strata that cover large geographical areas, as well as more recent Quaternary- age alluvial and superficial valley fill deposits that occur as localized events. The area within which the wind energy facilities are to be constructed is primarily underlain by *in situ* strata of the fossil-bearing Abrahamskraal Formation (*Pa*). Quaternary alluvial deposits, especially near water courses and drainage lines, have the potential to yield microfossil and fossil mammal remains as well as Early Stone Age archaeological remains. The proposed development is located within igneous bedrock (dolerite), and therefore represents no paleontological impact.

6.10 Description of the Environment - Summary of the Environmental & Social characteristics of the three project development phases

Table 4.13 Summary of the characteristics of the environment of the three project development phases

Environmental Characteristics	Phase 1 – Karusa Wind Farm	Phase 2 – Soetwater Wind Farm	Phase 3 –Great Karoo Wind Farm
1. Land Use and	Grazing land (sheep farming)	Grazing land (sheep farming)	Grazing land (sheep farming)
2. Land Capability	Low	Low	Low
3. Climate	Arid	Semi-Arid	Arid
4. Topography	Mountainous	Mountainous	Mountainous
5. Hydrology,	Dry or non-perennial	Dry or non-perennial	Dry or non-perennial

Environmental Characteristics	Phase 1 – Karusa Wind Farm	Phase 2 – Soetwater Wind Farm	Phase 3 –Great Karoo Wind Farm
Wetlands, Riparian Zones and Watercourses	drainage lines and watercourses present	drainage lines and watercourses present	drainage lines and watercourses present
6. Conservation Planning	» Namakwa District Biodiversity Sector Plan (NDBSP) – site contains CBA – T2[14] » Only parts of the site occurs on the Hantam-Roggeveld Centre of Endemism (HRC) » Site occurs in the Cape Floristic Region	» NDBSP – site contains CBA – T2 » Majority of the site occurs within the HRC	» NDBSP – site contains CBA – T2 » Majority of the site occurs within the HRC
7. Land Types	Fc272; Fc271, Fc267, Ib228; Ib229	Fc265; Fc266, Ib231; Ia54; Ib228	Fc265; Ib228; Ib227; Ib225; Ib226
8. Agricultural Potential	Low	Low	Low
9. Vegetation types	» All vegetation least threatened » Koedoesberge-Moordenaars Karoo » Central Mountain Shale Renosterveld	» All vegetation least threatened » Koedoesberge-Moordenaars Karoo » Central Mountain Shale Renosterveld	» All vegetation least threatened » Central Mountain Shale Renosterveld » Tanqua Escarpment Shrubland » Tanqua Wash Riviere
10. Bats	» Roosting potential is low to moderate » Turbines are located in high rise areas and	» Roosting potential is low to moderate » Turbines are proposed mostly on the western	» Roosting potential is high for Tanqua Escarpment Shrubland vegetation only.

[14] (EN (Endangered) and VU (Vulnerable) vegetation types, important terrestrial habitats (e.g. quartz patches, steep, south-facing slopes larger than 25 ha in size, kloofs, habitat for riverine rabbit), other important biodiversity areas that do not fall into T1).

Environmental Characteristics	Phase 1 – Karusa Wind Farm	Phase 2 – Soetwater Wind Farm	Phase 3 –Great Karoo Wind Farm
	therefore in areas where bat activity are less. However SM4 detected significantly igh bat activity and therefore the area around this system has been demarcated	ridge where bat activity is relatively low based on the passive detection results.	» Bats are expected to forage in the valley and low lying areas, as can be seen from the high activity detected by the control system SM6 in a valley
11. Birds	» More bird activity, in particular Verreauxs' Eagle, was observed along this ridge. In particular, proposed turbine locations 167, 173, 174 and 178 are directly traversed by several observed flight paths of Verreaux's Eagle and their locations may prove problematic in terms of collision risk.	» The southernmost row of turbines is outside of the birds' preferred flight areas, the northernmost row of turbines is very close to this area and there are a large number of observed flights within this area. However not many flights crossed over actual turbine locations.	» Limited bird flight data was collected in this area due to access and limited viewshed, but it is predicted to be a potentially higher risk area due to its suitable habitat, most of the turbines are currently positioned in areas of medium to high likelihood of priority species medium flights.
12. Heritage	» Grade III Heritage artefacts present on the site (graveyard, kraals, stone wall and old farmstead). » The area within which the wind energy facilities	» Grade III Heritage artefacts present on the site (stone walls, old farmstead and kraal). » The area within which the wind energy facilities are to be	» Grade III Heritage artefacts present on the site (stone wall, two graveyards and old farmstead). » The area within which the wind energy facilities are to be

Environmental Characteristics	**Phase 1 – Karusa Wind Farm**	**Phase 2 – Soetwater Wind Farm**	**Phase 3 –Great Karoo Wind Farm**
	are to be constructed is primarily underlain by in situ strata of the fossil-bearing Abrahamskraal Formation (Pa).	constructed is primarily underlain by in situ strata of the fossil-bearing Abrahamskraal Formation (Pa).	constructed is primarily underlain by in situ strata of the fossil-bearing Abrahamskraal Formation (Pa).
13. Social Characteristics		» Karoo Hoogland LM (Ward 4) » Nearest towns (Sutherland – Northern Cape & Matjiesfontein – Western Cape) » Sparsely populated » High unemployment	

ASSESSMENT OF IMPACTS: PHASE 1: KARUSA WIND FARM — CHAPTER 7

Environmental impacts associated with the proposed Karusa Wind Farm (Phase 1 of the Hidden Valley project) are expected to be associated with the construction, operation and decommissioning of the facility. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts can be expected to vary significantly from site to site.

The construction for a wind energy facility project include land clearing for site preparation and access/haul roads; transportation of supply materials and fuels; construction of foundations involving excavations and cement pouring; compaction of laydown areas and roadways, manoeuvring and operating cranes for unloading and installation of equipment; laying cabling; and commissioning of new equipment. Decommissioning activities may include removal of the temporary project infrastructure and site rehabilitation. Environmental issues associated with construction and decommissioning activities may include, among others, threats to biodiversity and ecological processes, including habitat alteration and impacts to wildlife through mortality, injury and disturbance; impacts to sites of heritage value; soil erosion; and nuisance noise from the movement of vehicles transporting equipment and materials during construction.

Environmental issues specific to the operation of a wind energy facility may include visual impacts; noise produced by the spinning of rotor blades; avian/bat mortality resulting from collisions with blades and barotrauma; and light and illumination issues.

These and other environmental issues were identified through the scoping evaluation. Potentially significant impacts identified have now been assessed within the EIA phase of the study. The EIA process has involved input from specialist consultants, the project proponent, as well as input from key stakeholders (including government authorities) and interested and affected parties engaged through the public consultation process. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts vary significantly from site to site.

This chapter serves to assess the identified potentially significant environmental impacts associated with the proposed wind turbines and associated infrastructure (substation, power lines, access road/s to the site, internal access roads between turbines, underground and overhead electrical cabling between turbines, turbine foundations), and to make recommendations regarding preferred alternatives for consideration by DEA, as well as for the management of the impacts for inclusion in the draft Environmental Management Programme (refer to **Appendix N**).

In order to assess the impacts associated with the proposed wind energy facility, it is necessary to understand the extent of the affected area. The affected area primarily includes the turbines, substation, overhead power lines and associated access roads. A wind energy facility is dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. The study area for the Karusa Wind Farm (approximately 145.3 km^2) is being considered as a larger study area for the construction of this phase of the proposed wind energy facility. The area to be occupied by turbines and associated infrastructure is illustrated **in Figures 7.1** below, and includes the area covered by the following six farm portions:

» Farm De Hoop 202
» Farm Standvastigheid 210
» Portion 1, Portion 2, Portion 3, and the remainder of Farm Rheebokke Fontein 209

The project will include the following infrastructure:

» Up to **74[15] wind turbines**, appropriately spaced to make use of the wind resource on the site. The generating capacity of the facility will depend on the final turbine selected for implementation but will be limited to 140MW at the point of connection with the Eskom grid. The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.
» Each wind turbine is expected to consist of a steel or concrete foundation (20m x 20m), a steel tower, a hub (between 80m and 120m above ground level, depending on the turbine size decided upon) and three blades with a rotor diameter of up to 120m.
» Cabling between the components, laid approximately 1 m underground where underground cabling is feasible. In as far as possible, cabling will follow the internal access roads[16].
» Internal roads (approximately 8 m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be used as far as possible.

[15] One turbine was erroneously included in Phase 2 which is now included into Phase 1. Therefore, Phase 1 originally had 75 turbines, and now has 74 turbines. Phase 2 originally had 55 turbines, and now has 56 turbines.

[16] Where underground cabling is not practical or environmentally sensible (e.g. in rocky area where blasting would be required), cabling would be above ground, suspended between ~8m high timber poles at ~60m centres.

However, the dispersed distribution pattern of wind turbines and the vast areas of the site which are not currently accessible will necessitate the construction of ~35 km of new access roads in some areas.

» A new on-site **substation** (with a capacity of up to 400kV) to connect to the Komsberg Substation located in the south west corner of the site development footprint. The substation will have a high-voltage (HV) yard footprint of approximately 40 000 m^2.
» Overhead 132 kV double circuit power line to connect the substation to the Eskom grid at the Komsberg Substation, requiring a servitude of approximately 36 m in width.
» **Operations and service building area** for control, maintenance and storage (approximately 2000m^2).
» **Guard house** for access security of 50$m^{2.}$

The assessment presented within this chapter of the report is on the basis of a layout provided by ACED. This layout indicates **74 wind turbines** and associated infrastructure. The assessment of issues presented within this chapter (and within the specialist studies attached within **Appendices F – S**) considers the worst-case scenario in terms of potential impacts.

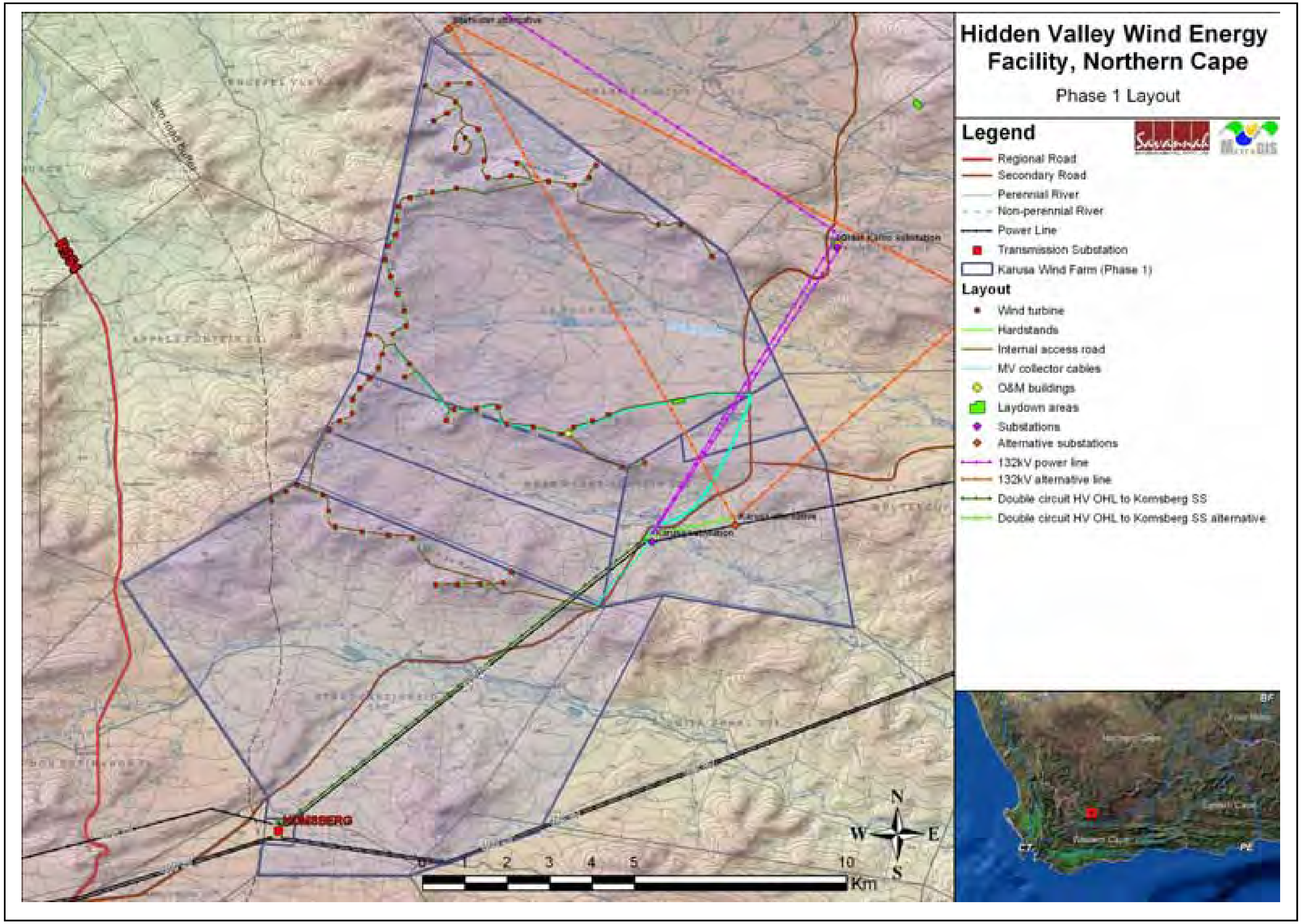

Figure 7.1 Layout of the Karusa Wind Farm, indicating the cluster of wind turbines to the northern and western portion of the site

7.1 Assessment of Potential Impacts on Ecology

The ecological sensitivity assessment identified those parts of the study area that could have high conservation value or areas sensitive to disturbance. Areas of potentially high ecological sensitivity are shown in **Figure 7.2**. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity. A map of remaining natural habitats and areas important for maintaining ecological processes in the study area is shown in **Figure 7.2**. Relatively fine-scale mapping was used to provide information on the location of sensitive features.

Any natural vegetation within which there are features of conservation concern have been classified into one of the high sensitivity classes (medium-high, high or very high). The difference between these three high classes is based on a combination of factors and can be summarised as follows:

1. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
2. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services.
3. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories.

The following areas occur on the site:

» Vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 (for this site - important terrestrial habitats that are south-facing slopes larger than 25ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (medium sensitivity).
» Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in natural habitats within the study area.
» Perennial and non-perennial rivers, streams and watercourses (high sensitivity).
» Areas classified as mountains, ridges or steep slopes: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).

Figure 7.2 shows the watercourses and drainage lines and steep slopes to have HIGH ecological sensitivity and conservation value. Natural vegetation on site that occurs within the Hantam-Roggeveld Centre of Plant Endemism (HRC) have MEDIUM-HIGH sensitivity, and other natural vegetation has MEDIUM sensitivity.

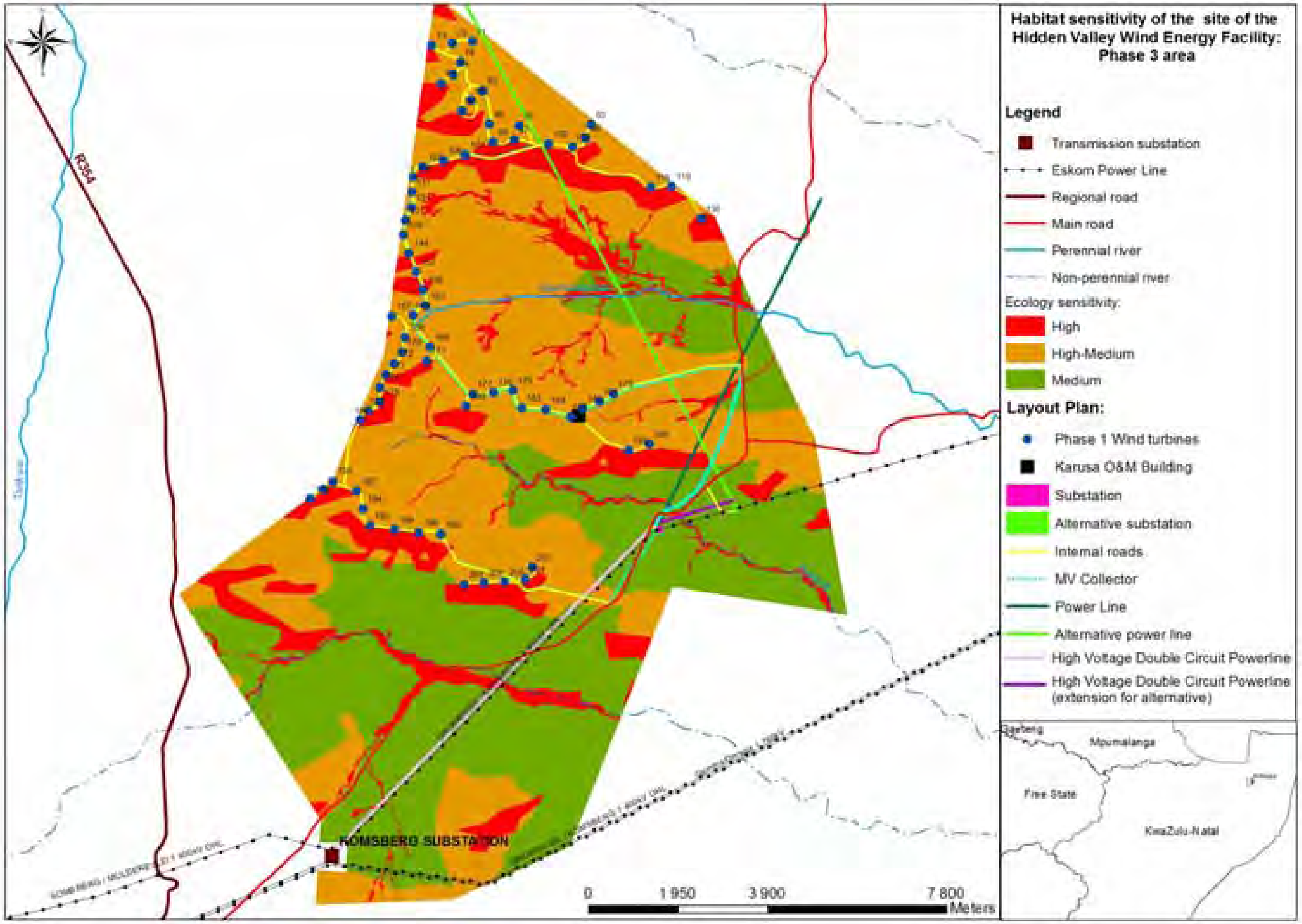

Figure 7.2: Ecological sensitivity map for the Karusa Wind Farm site, illustrating the location of sensitive vegetation, rivers, wetlands and CBAs)

7.1.1 Loss or fragmentation of indigenous natural vegetation

The remaining natural vegetation on site is classified as Least Threatened. However, the site falls within the Cape Floristic Region and the Hantam-Roggeveld Centre of Endemism. It is not expected that turbines structures will have a major effect on natural vegetation, due to the small footprint of each structure, but it is still likely that associated infrastructure such as the access roads and power line servitudes will cause negative impacts (disturbance and loss) on natural vegetation.

Construction of infrastructure associated with the proposed wind energy facility may lead to the direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of vegetation. Where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Consequences of the impact occurring may include:

» negative change in conservation status of habitat (Driver et al. 2005);
» increased vulnerability of remaining portions to future disturbance;
» general loss of habitat for sensitive species;
» loss in variation within sensitive habitats due to loss of portions of it;
» general reduction in biodiversity;
» increased fragmentation (depending on location of impact);
» disturbance to processes maintaining biodiversity and ecosystem goods and services; and
» loss of ecosystem goods and services.

7.1.1.1 Impact Table - Impact on indigenous natural vegetation types – wind energy facility and associated infrastructure (including access roads, power lines etc)

Nature: **Loss of habitat within indigenous natural vegetation types**		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	low (4)	Moderate to low (3)
Probability	definite (5)	definite (5)
Significance	**medium (60)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation: (1) Avoid unnecessary impacts on natural vegetation surrounding the turbines or access roads. The construction impacts must be contained to the footprint of the turbine, laydown area and access road. (2) Avoid unnecessary impacts on natural vegetation within power line servitudes. The construction impacts must be contained to the footprint of the servitude. (3) Rehabilitate any disturbed areas immediately to stabilise landscapes. (4) Consider implementing biodiversity offsets, such as stewardship programmes, alien removal or vegetation rehabilitation, to compensate for loss of indigenous natural vegetation.
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact on the site.
Residual Impacts: Some loss of vegetation will definitely occur.

7.1.2. Impacts on threatened plants

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, and possibly even local extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

» fragmentation of populations of affected species;
» reduction in area of occupancy of affected species; and
» loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances.

There are five plant species of conservation concern that have a geographic distribution that includes the site and which have a high chance of occurring in the study area. These include:

» three species classified as Vulnerable (*Romulea eburnea, Lotononis venosa and Geissorhiza karooica*) ; and
» two as Rare (*Cleretum lyratifolium and Strumaria karooica*).

The turbines are positioned in areas where these species are most likely to be found. The site is also the core distribution of these threatened species. Turbines are therefore likely to have an impact of medium significance on populations of threatened or rare plant species.

7.1.2.1 Impact Table - Impact on threatened plants

Nature: Impacts on threatened plants		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (42)**	**medium (36)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: (1) Disturbance of indigenous vegetation must be kept to a minimum, by relocation of wind turbines and associated infrastructure from areas of high ecological sensitivity as far as possible. (2) Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. (3) Prior to construction and once final infrastructure positions are known, the footprint of each turbine, access road and power line servitude must be searched for populations of potentially affected plant species of concern by undertaking a preconstruction survey for the species of concern should be undertaken in the footprint of proposed infrastructure to determine whether any of these species occur within the footprint of development or not. Depending on the density of individuals encountered, infrastructure positions to be modified to avoid important populations. If avoiding populations is not possible and any individuals of threatened species will be destroyed, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species. (4) If any populations are found in these areas, move infrastructure to avoid impact. (5) If not possible to relocate infrastructure, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.		
Cumulative impacts: Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be low if control measures are effectively applied		

7.1.3 Impacts on Wetlands or Watercourses

Construction may lead to some direct or indirect loss of or damage to seasonal marsh wetlands or drainage lines or impacts that affect the catchment of these wetlands. Without mitigation, this could lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

» increased loss of soil;
» loss of or disturbance to indigenous wetland vegetation;
» loss of sensitive wetland habitats;
» loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
» fragmentation of sensitive habitats;
» impairment of wetland function;
» change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
» reduction in water quality in wetlands downstream of road.

Turbines are not located within wetland areas. This potential impact is therefore not relevant to this infrastructure component and is scores as zero significance. Turbines are not located within wetland areas, but internal access roads linking turbines will probably have to cross wetlands in places.

7.1.3.1 Impact Table - Impact on Wetlands/ watercourses

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Short-term (4)
Magnitude	moderate (6)	minor (2)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Irreversible	Reversible to some degree
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Control stormwater and runoff water and inhibit erosion. » Disturbed areas must be rehabilitated as soon as possible. » Align internal access roads so that they branch directly from existing roads and go around wetlands as much as possible. If not possible, then the following measures must also be applied:		

» Obtain a permit from DWAF to impact on any wetland or water resource. » Cross watercourses close to existing disturbances. » Cross watercourses perpendicularly, where possible, to minimize the construction footprint. » Adequate culvert and/or bridge structures are required at crossings. » Construction must not cause the width of the watercourse to be narrowed.
Cumulative impacts: Soil erosion, alien invasions, may lead to additional impacts on wetland habitats that will exacerbate this impact.
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

7.1.4. Impacts on threatened animals and associated habitat

Potential negative impacts on populations are only likely for threatened species, which are the Riverine Rabbit and the Armadillo Girdled Lizard. Loss of habitat is the most important negative impact, which will occur primarily during the construction phase of the project. Turbines affect very little natural habitat and are not within areas considered suitable for the Riverine Rabbit. The known distribution of the riverine rabbit does not include the Karusa site, as shown in **Figure 7.3.**

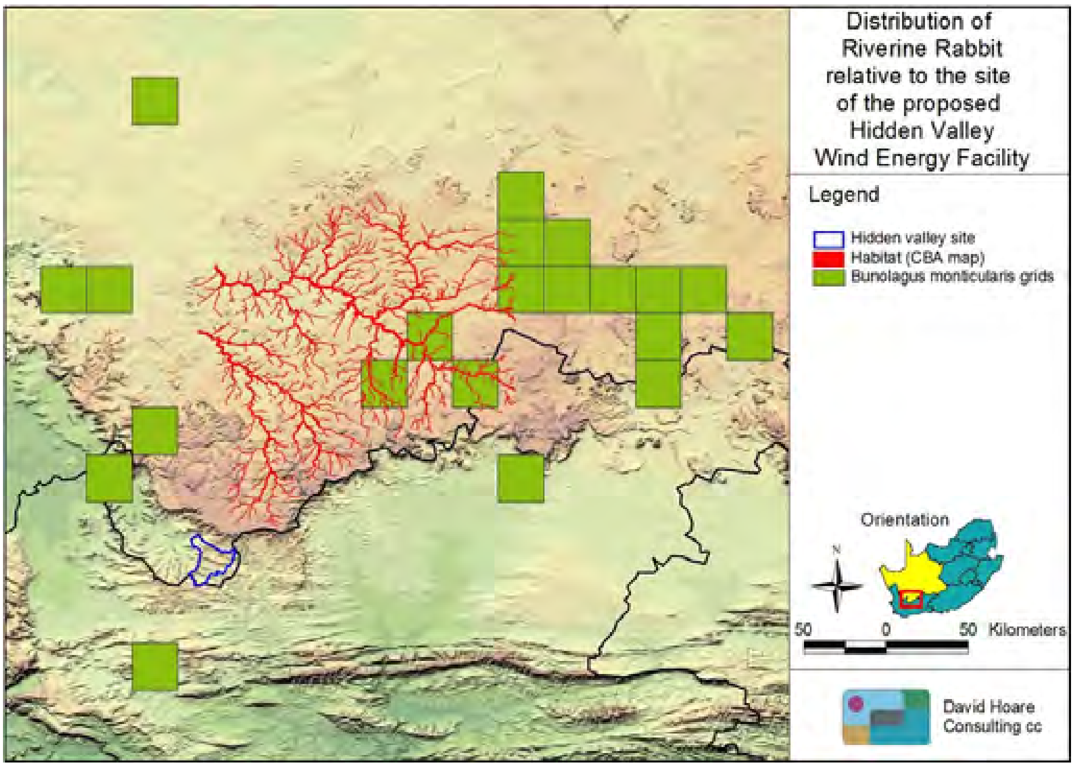

Figure 7.3: Known distribution of the Riverine Rabbit relative to the site.

Threatened animal species are affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species, and possibly even local extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

» fragmentation of populations of affected species;
» reduction in area of occupancy of affected species; and
» loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances. It is improbable that the impact will occur (it is not known whether the species of concern, the Riverine Rabbit and the Armadillo Girdled Lizard, will be affected or not - if they occur it is highly improbable that they will be affected). Based on the proposed position of turbines, no highly suitable habitat will be affected.

7.1.4.1 Impact Table - Impact on threatened animals / habitat

Nature: Impacts on individuals of threatened animal species		
	Without mitigation	**With mitigation**
Extent	local (3)	local (3)
Duration	permanent (5)	permanent (5)
Magnitude	low (4)	low (4)
Probability	Highly improbable (1)	improbable (2)
Significance	**low (12)**	**low (12)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	yes	
Mitigation: (1) Undertake a walk-through survey of areas with sandy soils once final infrastructure positions are known. (2) If any threatened animal populations are found in these areas, move infrastructure to avoid impact as far as possible.		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions) may exacerbate this impact.		
Residual Impacts:		

Unlikely to be residual impacts.

7.1.5. Establishment of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes high disturbance. Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

» loss of indigenous vegetation;
» change in vegetation structure leading to change in various habitat characteristics;
» change in plant species composition;
» change in soil chemical properties;
» loss of sensitive habitats;
» loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
» fragmentation of sensitive habitats;
» change in flammability of vegetation, depending on alien species;
» hydrological impacts due to increased transpiration and runoff; and
» impairment of wetland function.

There are very few concentrations of alien plants on site and habitat is in a natural state. Turbines will create areas of disturbance that will provide conditions in which alien plants are more likely to spread and thrive. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will enhanced by construction of turbines on site. A checklist of species previously recorded in the grid in which the site is located indicates that the following species are likely to invade the site, given the right conditions the following (*Salsola kali, Atriplex lindleyi, Opuntia ficus-indica, Opuntia imbricata, Prosopis glandulosa, Prosopis velutina, Atriplex numularia, and Nicotiana glauca).* The invasion of watercourses by alien plants is noted as a biodiversity issue of particular concern in the Namakwa District Biodiversity Sector Plan.

The wind turbine, substation, access roads and other infrastructure will create new nodes of disturbance within an otherwise undisturbed landscape. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will be enhanced.

7.1.5.1 Impact Table - Alien vegetation growth due to disturbance

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	long-term (4)
Magnitude	moderate (6)	Minor (2)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

- Keep disturbance of indigenous vegetation to a minimum.
- Rehabilitate disturbed areas as quickly as possible
- Do not translocate soil stockpiles from areas with alien plants
- Control any alien plants, especially within wetlands and watercourses
- establish an on-going monitoring programme to detect and quantify any aliens that may become established

Cumulative impacts:

Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.

Residual Impacts:

Will probably be very low if control measures are effectively applied

7.1.6. Vegetation and habitat loss due to new access roads

The construction of new access roads to the site and to each wind turbine has the potential to result in negative impacts on ecology. Access roads will entail clearing of vegetation, therefore vegetation loss and habitat loss for plant species. Creation of access roads causes nodes of disturbance, and may become hotpots for soil erosion. This impact could occur on the site, and presents a risk particularly on steep slopes and hills, where turbines are proposed. Some access roads may inevitably cross drainage lines, which may cause downstream effects on watercourse, cumulatively. Therefore the impact of access roads, without environmental control measures may be of a moderate significance and with mitigation this impact could be manageable.

7.1.6.1 Impact Table – Impact of access roads on ecology

Nature: Loss of habitat within indigenous natural vegetation types, disturbance and soil erosion due to creation of permanent access roads.		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	Permanent (5)	permanent (5)
Magnitude	moderate (6)	Moderate (5)
Probability	definite (5)	probable (3)
Significance	**medium (60)**	**medium (33)**
Status (positive or negative)	negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » Internal access roads must make use of existing roads on site, as much as possible. Where new roads are to be constructed, these should follow existing tracks or disturbed areas or the edges of disturbed areas as far as possible. » Avoid unnecessary impacts on natural vegetation surrounding the turbines. The construction impacts must be contained to the footprint of the turbine and laydown area. » Disturbed areas must be rehabilitated as quickly as possible		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of natural vegetation type is likely to occur, but only a small extent is potentially at risk.		

7.1.7. Comparative Assessment of Grid Connection Alternatives

Karusa Substation Option 1 (the technically preferred substation location) is preferred, as Substation Option 2 is located near one of the ridgelines in the study site which is considered of high sensitivity, as per the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 area (steep slopes).

7.1.8. Cumulative impacts

To some extent a cumulative impact is a regional impact, rather than the local site scale impact, i.e. if something has a regional impact it also has a cumulative impact. Cumulative impacts for this assessment will include any approved wind energy facilities in the area. The cumulative impact of the Karusa Wind Farm has been considered two levels:

- Firstly, impacts of the Karusa Wind Farm plus the other two development phases of the Hidden Valley project (i.e. Phase 2 – Soetwater Wind Farm and Phase 3 – Great Karoo Wind Farm).
- Secondly, the additive impact of this project and other approved wind projects within a 10 – 20 km radius of the site. Based on the information available at the time of undertaking this EIA, four wind energy facilities have an

environmental authorisation and occur in close proximity to the Hidden Valley projects which are listed in the Table 1 below.

Table 1: List of Wind Energy Facilities Proposed in the Study Area

Wind Farm (Developer)	No. of turbines	Distance (km)	Status of the development	DEA Reference Number
1. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Roggeveld	Authorisation received	12/12/20/1783
2. Witberg Wind Farm (G7 Renewable Energies)	Up to 27	Approx. 25km south of Roggeveld	Authorisation received	12/12/20/1966
3. Sutherland (wind and solar) (Mainstream SA)	293 to 386	Approx 35km north east o/f Roggeveld	Authorisation received	12/12/20/1782
4. Suurplaat Wind Farm (Moyeng Energy)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received	12/12/20/1583
5. Roggeveld Wind Farm (G7 Renewable Energies)	Approximately 207	Adjacent to the Hidden Valley site (to the west)	EIA in process	12/12/20/1988/1-3
6. Gunstfontein (wind and solar) Networx Eloes	Approximately 100	Adjacent to the Hidden Valley site (to the north)	EIA in process	14/12 /16/3/3/2/399 (wind) 14/12/16/3/3/2/395 (solar)

Cumulative ecological impacts are expected to be of a moderate significance and include cumulative loss of biodiversity (particularly for protected plants and animal species and soil erosion), and can be effectively mitigated through sound environmental management (mitigation measures) during construction and operation covered in the EMPr and by formal conservation and active management of the natural areas on site. With the implementation of this mitigation, cumulative impacts on ecology as a result of the establishment of various wind energy facilities in the area could be of an acceptable level.

Cumulative effects are however highly uncertain due to the complexities of wind farm development and the likelihood that not all planned wind farms in the area will ultimately be constructed.

7.1.9. Conclusions and Recommendations

The overall impacts of this proposed project are of low or moderate significance in most cases, but of potentially high significance on populations of threatened plant species due to the proposed location of selected turbines in areas of potentially high sensitivity. With mitigation measures implemented, it should be possible to reduce all negative impacts to low significance, except on populations of threatened plants and on natural vegetation, where the impact is likely to remain of medium significance. Potential impacts on vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2, habitat for threatened plants and animals, wetlands / watercourses and non-perennial rivers occur on the site, particularly in areas of High sensitivity which are indicated in **Figure 7.2**. These are not necessarily “no-go” areas, but areas of high ecological sensitivity. If impacts on threatened and protected species are managed, it should be possible to develop within these areas of high sensitivity. However, it is recommended that wetlands / watercourses should be avoided as far as possible.

The following pertinent recommendations are made:

» A comprehensive search for threatened and near-threatened plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure is known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate infrastructure, a permit may be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.
» Preferred substation site is Karusa Substation Option 1.
» Consider implementing biodiversity offsets, such as stewardship programmes, alien removal or vegetation rehabilitation, to compensate for loss of indigenous vegetation.
» Establish an on-going monitoring programme to detect and quantify any alien plant species that may become established as a result of disturbance.
» Implement mitigation measures as stipulated in the EMPr
» Appoint an ECO during construction.

7.2 Assessment of Potential Impacts on Avifauna

The findings of the pre-construction bird monitoring programme have been incorporated into this section, supplementary to the avifaunal impact assessment (EWT, February 2012).

The effects of a wind energy facility on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss causes a reduction in birds using an area which might then reduce the risk of collision). The principal areas of concern are:

- Bird Mortality due to collision with the wind turbines.
- Displacement due to disturbance and Habitat loss due to the footprint of the wind farm.
- Bird mortalities from collisions with the associated power lines.
- Electrocution of birds by power lines.

Based on the pre-construction bird monitoring programme, sixteen (16) priority bird species were identified on the site including:

- African Harrier-hawk
- Amur Falcon
- Black-shouldered Kite
- Blue Crane
- Booted Eagle
- Gabar Goshawk
- Jackal Buzzard
- Lanner Falcon
- Ludwig's Bustard
- Martial Eagle
- Rock Kestrel
- S. Pale Chanting Goshawk
- Southern Black Korhaan
- Steppe Buzzard
- Verreauxs' Eagle
- Yellow-billed Kite

The Avifaunal Impact Assessment study (EWT 2012) presented avian sensitivity maps, which were generated using site visit information, aerial imagery, and vegetation, and avifaunal habitat mapping. This information was used to determine the avian risk maps developed for the pre-construction bird monitoring report. The EWT recommended exclusion zones for Hidden Valley site and the original turbine layout is shown in Figure 7.4.

The sensitivity categories were assigned using the following factors:

» High sensitivity: The high sensitivity zones include the Rivers and Streams in the study area buffered by 150m on either side, ridge buffers were not included on the map as flight data was used instead. These zones represent potential high sensitivity areas. These areas should be considered in the final layout of the facility and when positioning the wind turbines. However, it is strongly recommended that current turbine positions within these zones be moved, especially those along ridge edges, which should be moved 100m (or more) back from the ridge edge. Associated infrastructure, including roads, power lines and buildings, should avoid these zones. The confidence with which these "High sensitive" areas were identified was medium, and the extent of these zones are indicated in the flight models below with high likelihood ratings.
» Medium Sensitivity: The medium sensitivity zones identified are farm dams as well as certain low risk ridges. These dams and ridges were primarily identified at a desk top level while the presence of a few were confirmed during the site visit as being potentially important to avifauna. However construction of infrastructure may be possible, with caution, in these areas with medium likelihood.
» Low Sensitivity: These are the remaining areas with little likelihood. No obvious avifaunal features or patterns could be identified during the study. However some areas could be designated as Medium in the future upon availability of new data and/or after additional site analysis or pre-construction monitoring. At this there is no proven reason that infrastructure should not be built in these areas. Therefore, these Low sensitivity areas are preferred for construction, particularly of early phases.

Based on the results of the pre-construction bird monitoring twelve (12) wind turbines from the original layout (79, 81, 86, 90, 107, 110, 167, 173, 174, 178, 182 and 34 (lies in river buffer zone)) fell within the high risk areas for avifauna. These turbines have been relocated to areas outside of the high risk areas as shown in Figure 7.4, and as informed by the pre-construction bird monitoring study. The applicant has thus adhered to the recommendations made by the avifaunal specialists and no turbines are placed within high risk areas. This is shown in discussed in more detail in the conclusions chapter 8. .

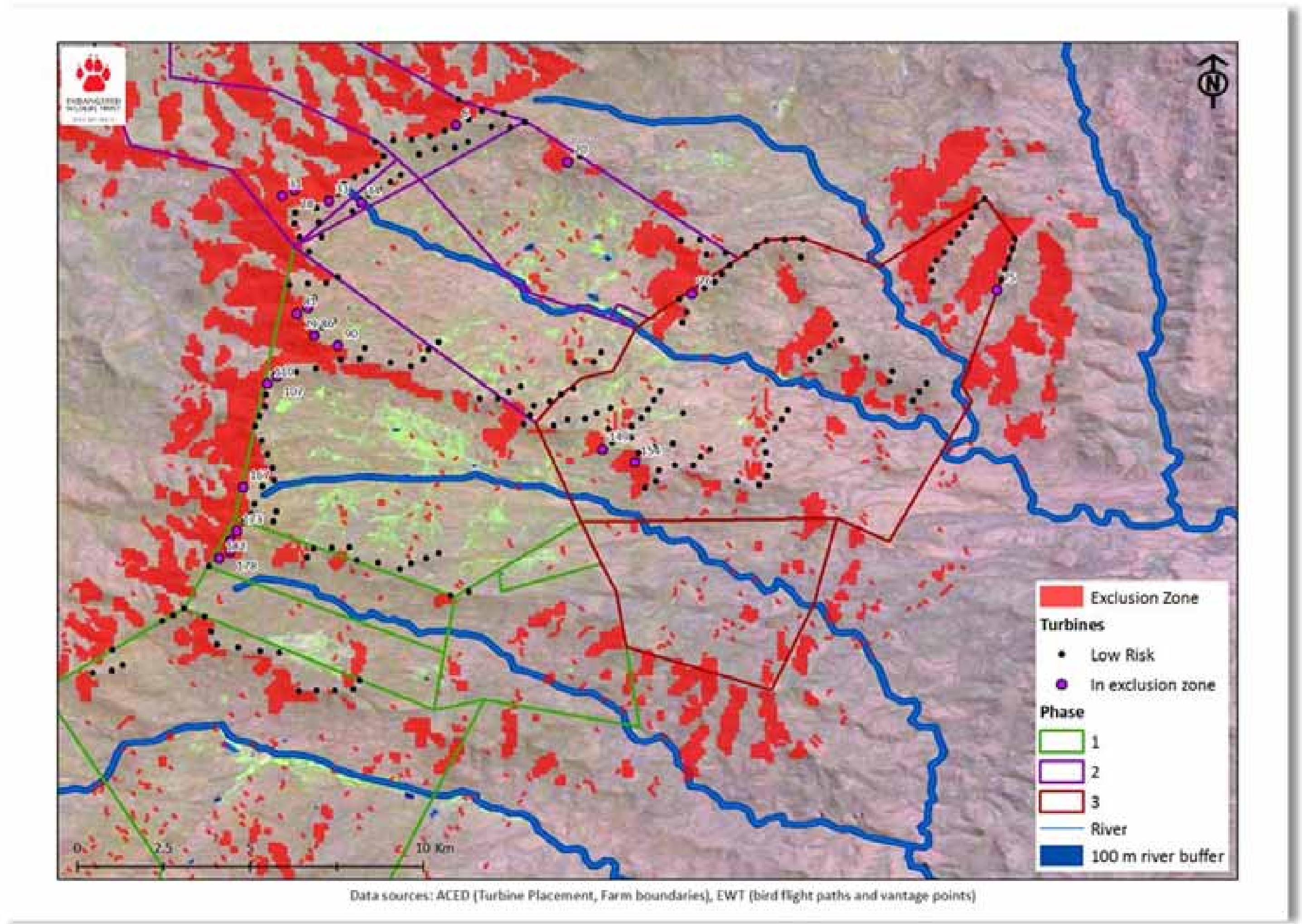

Figure 7.4: EWT recommended exclusion zones for Hidden Valley site and the original turbine layout

7.2.1 Bird Mortalities due to collisions with wind turbines

The three main hypotheses proposed for birds not seeing turbine blades are as follows (Hodos, 2002):

» An inability to divide attention between prey and obstacles. This seems an unlikely explanation as birds have been found to maintain good acuity in the peripheral vision, have different foveal region in the eye for frontal and ground vision and they have various other optical methods for keeping objects at different distances simultaneously in focus.
» The phenomenon of motion smear or retinal blur.
» The angle of approach. If a bird approaches from side on to the turbine, the blades present a very small profile and are even more difficult to detect.

7.2.1.1 Impact Table - Bird Mortalities due to collisions with wind turbines

Nature of the Impact: Collision of birds with turbines Karusa Wind Farm		
	Without Mitigation	**With Mitigation**
Extent	(2) Site- Impact will occur locally, but have national implications for certain species	(2) Site- Impact will occur locally, but have national implications for certain species Long term (4
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Very high (10)
Probability	Probable (3)	Probable (3)
Significance	**Medium (48)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Partially	

Mitigation

» The most important mitigation option is the correct positioning of turbines outside of the identified high sensitivity zones, and where possible, outside of the medium sensitivity zones. **This mitigation measure, the micro-siting, has already been undertaken during the feasibility phase of this project to guide the final turbine layout and the high risk turbines were moved into medium/low sensitivity areas as part of a mitigation strategy.**
» A post-construction monitoring program will be vital to determine additional mitigation measures or the behaviour of the bird species.
» Additional available or potential mitigation options therefore would need to be employed once the turbines are already operational, if monitoring reveals significant impacts.

» Some mitigation options that can be employed if monitoring reveals significant numbers of collisions, include: that one blade be painted black, in order to provide an alternating image for the bird in flight; curtailment, i.e. shutting down certain turbines at certain times; manipulation of blade height to accommodate predominant bird flight height, and any others that may be identified as our understanding of the impacts progresses.
Cumulative impacts: The cumulative impact of bird collisions in the area may be significant. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with overhead cables in the area.
Residual impacts: Undetermined

7.2.2 Displacement of Birds due to Disturbance and habitat loss

During the construction phase habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, through the modification of habitat. During the construction and maintenance of electrical infrastructure, a certain amount of disturbance also results. For shy, sensitive species this can impact on their usual daily activities, particularly whilst breeding.

7.2.2.1 Impact Table - Impact on birds due to disturbance

Nature of the Impact: Disturbance and habitat loss of birds during construction of Karusa Wind Farm		
	Without Mitigation	**With Mitigation**
Extent	Local – Site & Immediate Surrounds Only) (2)	Local – Site & Immediate Surrounds Only) (2)
Duration	Short Term (2)	Short Term (2)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (40)**	**Medium(30)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Partially	
Mitigation		

» Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff. » Sensitive zones described elsewhere in this report, should be avoided where possible. It is difficult to mitigate properly for this as some disturbance is inevitable as a result of the use of equipment and heavy vehicles. » Environmental measures to be detailed in the site specific EMP and will be enforced and overseen by the ECO for the project. During the construction phase a site walkthrough is recommended so that the avifaunal specialist can identify any breeding sensitive bird species in close proximity to specified turbines and associated infrastructure positions. If any of the "Focal Species" identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted for further instruction. It is recommended that a ridge survey is undertaken for the identification of nesting sites before construction.
Cumulative impacts It is impossible to say at this stage what the cumulative impact of all the proposed wind developments will be on birds, firstly because there is no baseline to measure it against, and secondly because the extent of actual impacts will only become known once a few wind farms are developed. It is therefore imperative that pre-construction and post-construction monitoring is implemented any accepted / endorsed bird monitoring guidelines / standards to provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species.
Residual impacts Low

7.2.4 Collision / Electrocution of Birds by Power line

The proposed power lines (one which is few metres in length from the 400 kV substation to the 400 kV existing power line and a double circuit power line up to 12 km in length to Komsberg Substation) that will link the wind facility to the grid could pose an avifaunal collision risk. Because of their size and prominence, power lines constitute an important interface between birds and people.

» ***Collision:*** Collisions of birds with a power line are a threat to birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the result that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

» ***Electrocution of birds by power line:*** This scenario occurs when a bird is perched or attempts to perch on the electrical structure (such as a power line) and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution is possible on 132kV lines or lower. The electrocution risk of the associated overhead power lines can only be assessed once the tower structure to be used is known. Species that could be impacted upon include herons, storks, and some large eagles.

7.2.4.1 Impact Tables – Electrocution of birds with the overhead Power lines

Nature of the Impact: Electrocution of birds on associated overhead power lines at Karusa Wind Farm.		
	Without Mitigation	**With Mitigation**
Extent	Site- Impact will occur locally, but have national implications for certain specie (2)	Site- Impact will occur locally, but have national implications for certain specie (2)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Very high (10)
Probability	Probable (3)	Very improbable (1)
Significance	**Medium (48)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation Associated power-lines should be placed underground where possible. Any overhead power lines which are built, and which are above ground and are 132kV or lower, should use a "bird friendly" monopole structure, fitted with a bird perch, as per Eskom standard guidelines.		
Cumulative impacts The power line network in the study area is a source of unnatural mortality for large terrestrial species, specifically Blue Cranes and Denham's Bustard. This power line will further increase the cumulative risk posed by the network.		
Residual impacts Low		

7.2.4.2 Impact Tables – Collision of birds with the Power line

Nature of the Impact: Collision of birds with associated overhead power lines at Karusa Wind Farm

	Without Mitigation	**With Mitigation**
Extent	Site- Impact will occur locally, but have national implications for certain species (2)	Site- Impact will occur locally, but have national implications for certain species (2)
Duration	Long term (4)	Long term (4))
Magnitude	Very high (10)	Very high (10)
Probability	Probable(3)	Some probability (2)
Significance	**Medium (48)**	**Medium (32)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Partially	
Mitigation Distribution power lines connecting turbines should be placed underground were it is feasible to do so. Mark relevant sections of the overhead power lines (i.e. within the Medium-High Sensitivity zones) with appropriate marking devices. The exact spans will be finalised as part of the EMPr phase (during micrositing/site walkthrough), once power line routes are finalised and pylon positions are pegged.		
Cumulative impacts The cumulative impact of bird collisions in the area is may be significant. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with overhead cables in the area. If additional power lines in the broader are built, they may further impact on these target species' populations.		
Residual impacts Undetermined		

7.2.5 Comparative Assessment of Grid Connection Options

The power line and substation alternatives in relation to the avifaunal sensitivity map are shown in Figure 7.5. The two substation alternatives are located outside of the high and medium avifauna areas (as shown in **Figure 7.5**); therefore both options are therefore considered acceptable. Option 1, including the power lines to Komsberg Substation is preferred. It is recommended that power lines follow existing fencelines, roads and farm roads and other existing linear infrastructure where possible or adhere to exclusions and buffer zones where possible. The power line follows the existing Eskom 400kV power line and collision mitigation, in the form of "bird flight diverters" fitted to the required sections of line, must be identified through a site "walkthrough" prior to construction to position power line towers.

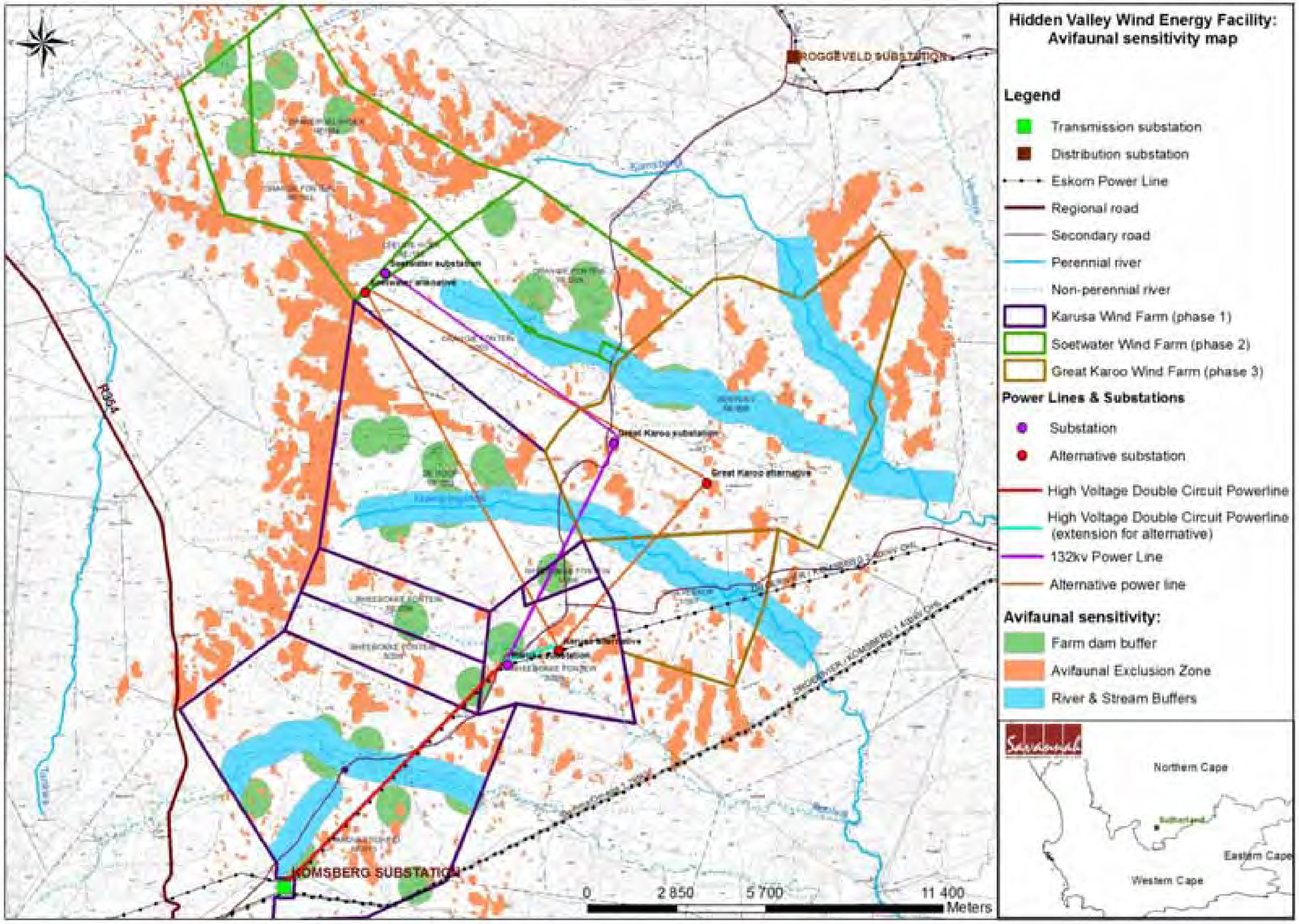

Figure 7.5: Grid Connection Options for Phase 1 (also shown in other Phases) overlain with avifaunal sensitive areas

7.2.6. Cumulative impacts

The cumulative impact of the Karusa Wind Farm has been considered at two levels:

» Firstly, impacts of the Karusa Wind Farm plus the other two development phases of the Hidden Valley project (i.e. Phase 2 – Soetwater Wind Farm and Phase 3 – Great Karoo Wind Farm), and. The three –phased development of the Hidden valley project could have cumulative effects facilities on bird species of conservation concern may be moderate to high, without mitigation. However, with mitigation, the cumulative effects will be of acceptable levels.
» Secondly, the additive impact of this project and other approved wind projects within a 10 – 20 km radius of the site. It is impossible to say at this stage what the cumulative impact of all the proposed wind developments in this region of the Northern Cape will have on birds, firstly because there is no baseline to measure it against, and secondly because the extent of actual impacts will only become known once a commercial wind energy facility is developed in South Africa / the Northern Cape. Based on the information available at the time of undertaking this EIA, four wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site which are listed in the Table 7.1.

The cumulative effect of surrounding wind energy facilities with the proposed Hidden Valley wind energy facility will increase the significance of the following impacts:

» Collision with turbines
» Impacts with overhead power lines
» Disruption in local bird movement patterns

The cumulative effect of the four or more wind energy facilities, within a 10-20 km radius of each other on bird species of conservation concern may be of moderate significance. It is therefore imperative that pre-construction and post-construction monitoring is implemented in line with any accepted / endorsed bird monitoring guidelines / standards to provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. This will provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. At this stage, indications are that displacement may emerge as a significant impact, particularly for the target species such as Ludwig's Bustard Black Stork, Southern Black Korhaan, Martial Eagle, Jackal Buzzard, Greater Flamingo, Lesser Kestrel and assorted waterfowl, and waders. In some cases, these species serve as surrogates for other similar species, examples being Lesser Kestrel for Rock Kestrel, and Southern Black Korhaan or Karoo Korhaan.

The impact tables below are based on the assumption that 50% of the applications for the surrounding farm areas will be approved / have been approved (based on public information regarding existing applications).

Nature: Cumulative avian collision with turbines		
	Without mitigation	**With mitigation**
Extent	Medium (2)	Medium (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	High(8)	High(8)
Probability	Probable (3)	Probable (3)
Significance	**Medium (39)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	limited	

Nature: Cumulative Impacts with overhead power lines		
	Without mitigation	**With mitigation**
Extent	High (3)	Medium (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	High(8)	Moderate (6)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (56)**	**Low (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	limited	

Nature: Disruption in local bird movement patterns		
	Without mitigation	**With mitigation**
Extent	High (3)	High (3)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (48)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	no	no
Can impacts be mitigated?	No	

The cumulative impact of bird collisions in the area may be moderately significant should the wind farms ever be developed. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with any existing overhead cables in the area as a result of their flight patterns and physical characteristics. If other proposed wind projects in the broader area are built, they may further impact on these target species' populations. An additional mortality factor such as collision with turbines may prove detrimental to local populations of these species. Additional wind projects will increase the overall distance and spans of overhead lines in the area to connect with the nearest sub-station.

Cumulative effects are however highly uncertain due to the complexities of wind farm development and the likelihood that not all planned wind farms in the area will ultimately be constructed. Furthermore, with the appropriate pre- and post-construction monitoring potential impacts can be mitigated through correct turbine and overhead line placement as well as overhead line flappers and alike.

7.2.7. Conclusions and Recommendations – Avifauna

» Collision with the turbine blades is likely to be the most significant impact, to which all of the focal species are vulnerable. With a project of this size, habitat destruction may also be significant.
» The proposed site was found to be moderately sensitive in terms of avifauna, with areas of high, medium and unknown sensitivity being present on site and a large number of sightings of priority birds specifically soaring species utilising the topography on site.
» There are no fatal flaws associated with the site, and the project should proceed subject to the moving of turbines out of high risk areas to areas of lower risk as identified in the pre-construction bird monitoring report.
» Numerous ridges to the west and north of the site represent areas of high sensitivity, and where possible it is recommended that turbines be moved out of these zones to medium and low sensitivity areas. Based on the results of the pre-construction bird monitoring twelve (12) wind turbines turbines of the original layout (79, 81, 86, 90, 107, 110, 167, 173, 174, 178, 182 and 34 (lies in river buffer zone) fell within the high risk areas for avifauna. These turbines have been relocated to areas outside of the high risk areas as presented in the conclusions chapter (Chapter 9) as informed by the pre-construction bird monitoring study.
» In terms of the "no-go" alternative, the current status quo would be maintained by not implementing the proposed wind farms. The current farming activities will continue and the land use will not change. Presence and abundance of bird species, as described in the Avifaunal EIA Report, would remain the same. Purely in terms of impacts on avifauna, this option would have the least impacts.
» In terms of the substation and power line layout alternatives, substation and power line Option 1 is preferred for Phase 1.

» As per the best practice guidelines, post-construction should be undertaken to compare the data before and after the presence of operational turbines. It is recommended that the power line routes follow existing roads and servitudes and avoid the buffer zones identified as far as possible. An avifaunal “walkthrough” or “micro-siting” site visit is always recommended for power-line alignment and for position of masts.
» The EMPr contains a draft operational phase bird monitoring programme.

7.3 Impacts on Bats

7.3.1 Results of the Pre-Construction Bat Monitoring Programme

In order to characterise the bat community (baseline) a pre-construction bat monitoring programme was undertaken at the Hidden Valley Wind Energy Facility site and at a control site by Animalia cc. The bat monitoring report also contains an assessment of the potential impacts of the wind energy facility on bats. The pre-construction bat monitoring and assessment report is attached to Appendix S. The results of the pre-construction bat monitoring to date confirmed that there are three bat species (one species considered as “near threatened” (the Natal long-fingered bat) and two considered as species of “least concern (the Cape Serotine bat and the Egyptian Free-tailed bat) which occurred at the proposed Hidden Valley wind energy facility site. The bat monitoring study found that high localised bat activity at certain times of the year occurred on the wind energy facility site although not in close proximity to any planned turbine positions.

Figure 7.6 and Figure 7.7 depicts the bat sensitive areas of the Karusa site, based on features identified to be important for foraging and roosting of the species that are confirmed and most probable to occur on site. This map has been used as to inform the pre-construction mitigation and planning in terms of improving turbine placement in relation to preferred habitats bat on the site.

In terms of the bat sensitivity map, the following categories have been used:
» Moderate Sensitivity: Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology, with an expected relative higher risk of impacting on local bats. Turbines within or close to these areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and mitigation measures, if any is needed.
» High Sensitivity and their buffers: Areas that are deemed critical for resident bat populations, capable of elevated levels of bat activity and support greater bat diversity than the rest of the site. These areas are ‘no-go’ areas and turbines must not be placed in these areas.

The following is relevant regarding turbines in relation to the bat sensitivity map:

» Based on the current layout for the Karusa phase no turbines occur in the areas of high sensitivity.
» Turbine 118 used to occur in the high sensitivity buffer but has subsequently been removed.
» No turbines occur in the moderate sensitivity area and its buffer.
» Turbines 73, 204, 205 and 207 occur immediately outside of moderate bat sensitivity buffer but have subsequently been removed.

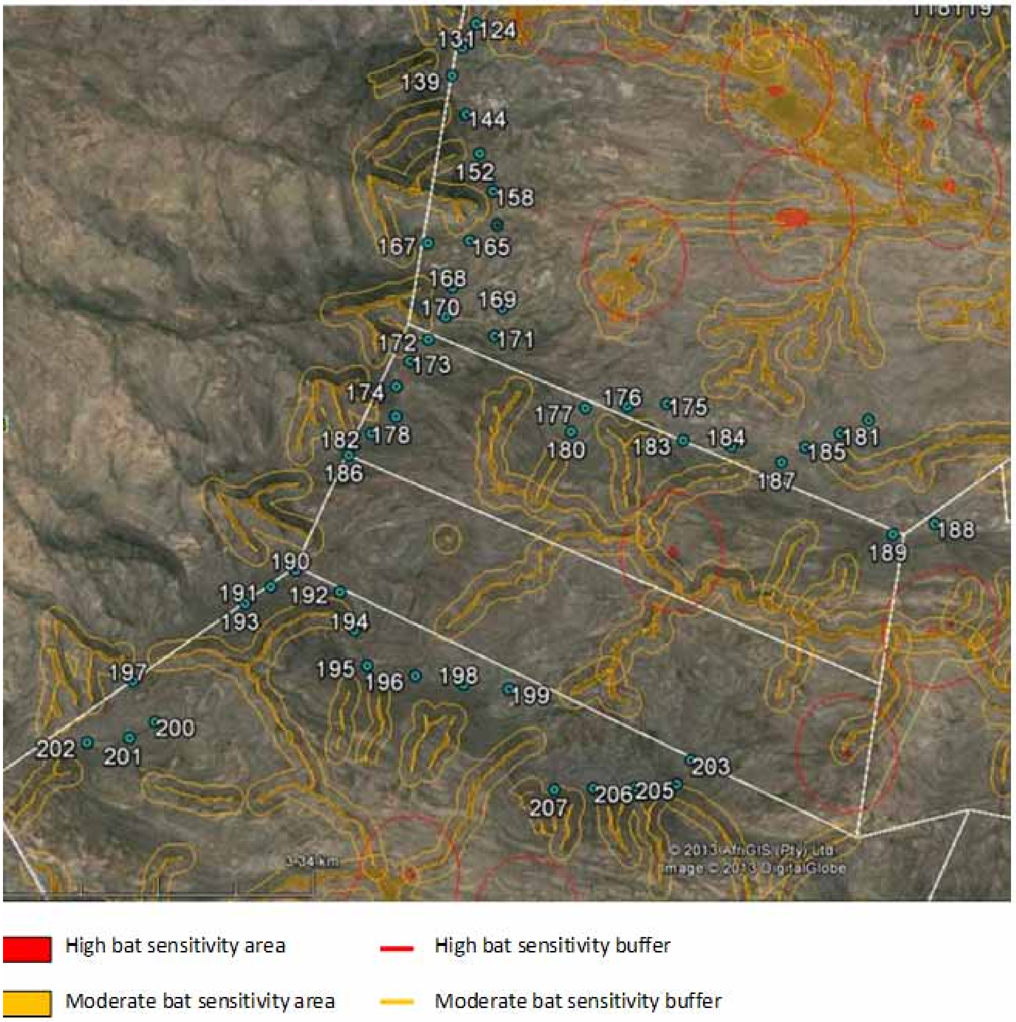

Figure 7.6: Sensitivity map of the southern portion of the proposed Karusa wind farm turbine layout.

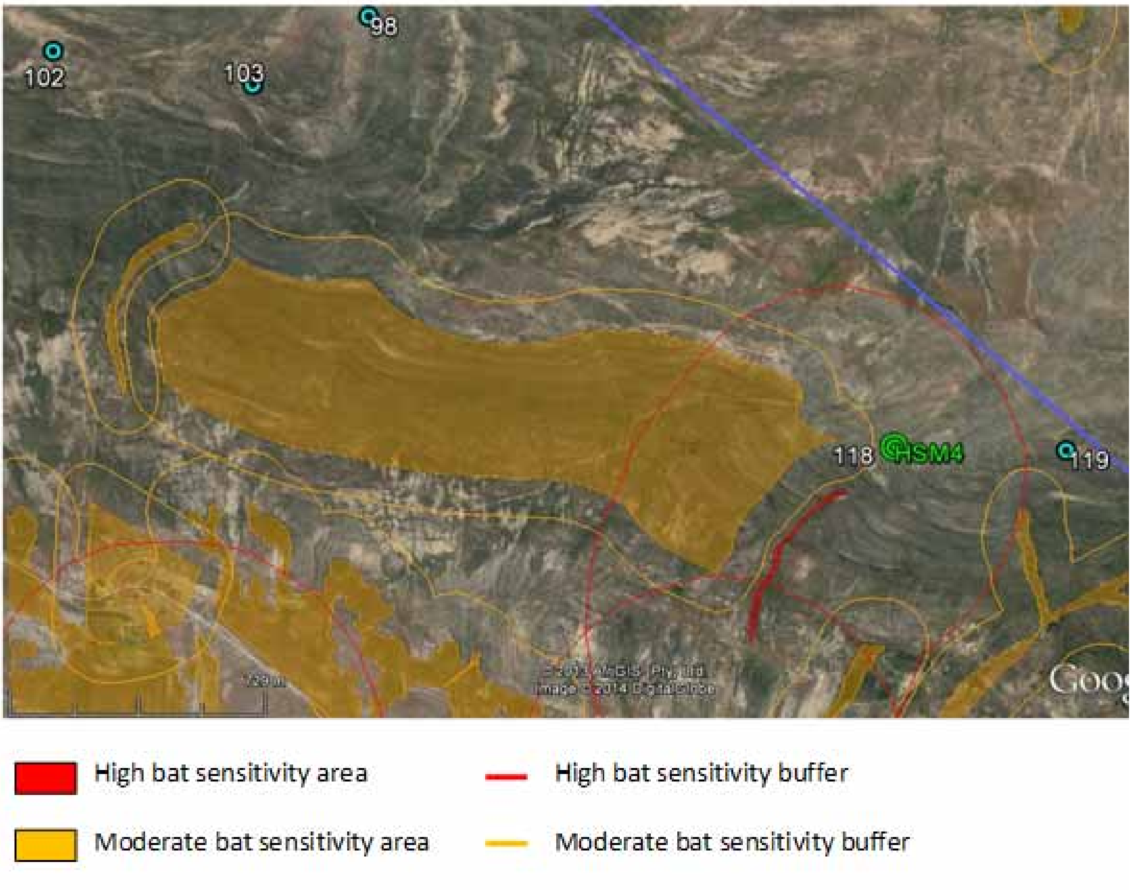

Figure 7.7: Sensitivity map of the area around SM4 in the northern portion of the original proposed Karusa wind farm turbine layout.

Hill slopes in the area of SM 4 may be hosting *Tadarida aegyptiaca* (Egyptian Free-tailed bat) roosts, based on the transect results and high activity of this species recorded by SM 4. The activity recorded at SM 4 seems to be significantly affected by climatic conditions such as wind speed and temperature. It is recommended that Turbine 118 is moved out of the High sensitivity area indicated in Figure 7.18. This has been undertaken and a revised layout is presented in the conclusions chapter.

The Karusa Wind Farm (Phase 1) has a diversity of habitats for bats, including moist drainage areas, open surface water, limited farm buildings for roosting and some crevice roosting space on the hill slopes. Bat activity at SM4 showed significant peaks during October and November 2013 of particularly *T. aegyptiaca* and during both the 2nd and 3rd site visits transects activity was significant around this system. The only exception to the control (SM6) not having the highest activity is the months of October 2013 and November 2013 where SM4 showed higher activity of *T. aegyptiaca* than SM6, strengthening the motivation for mitigation measures around SM4.

It is expected that the hill slope directly adjacent to the south of SM4 could offer substantial roosting space to the crevice dwelling *T. aegyptiaca* and furthermore that the system may be flanked by suitable water drainage foraging terrain on the north and south, with bats commuting from the roosting space in the south to the northern foraging terrain. As such the area around SM4 could be sensitive to bat impact and thus it was recommended that turbine 118 be relocated outside of the bat sensitivity area as indicated in the latest revision of the sensitivity map. This was actioned by the developer who in arriving at the layout presented for Authorisation, also elected to even move some turbines so as to also avoid Moderate bat sensitivity buffer zones. The solution is considered robust and no further movements of turbines are required.

The impact of the wind turbines for the Karusa Wind Farm on bats is expected to be low significance if layout revisions adhere to the sensitivity map. Due to the low bat activity recorded by passive systems on this phase, and the localised bat activity around SM4, confidence in the impact statement is high.

7.3.2 Impact Tables summarising impacts on bats

Wind turbines can cause bat mortalities due to collision of bats with the wind turbine blades, however more often due to barotrauma. Barotrauma refers to bat deaths due to tissue damage to air- containing structures caused by rapid or excessive pressure change close to the rotating wind turbine blades surface. Death is usually caused by pulmonary barotrauma where lungs are damaged due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald et al., 2008). The potential collision risk is not the same for all bat species and it varies according to the species' habits and ecology. Construction may result in habitat loss of based, which is also assessed in the tables below.

Nature: Bat mortalities due to direct blade impact or barotrauma during foraging (not migration) Turbines are located in high rise areas and therefore in areas where bat activity are less. Significantly high bat activity was detected and therefore the area around this system has been demarcated on the sensitivity map.		
	Without mitigation	**With mitigation**
Extent	Low-medium (2)	Low-medium (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

» Adhere to the sensitivity map,
» Either apply mitigations to turbine 118 or move it completely out of High or Moderate bat sensitivity areas.
» Mitigations that need to be applied if turbines are not moved is implementation of curtailment between 1 October to 15 November (between 21:00 and 3:00) under the following environmental conditions: below 7.5 m/s measured at 10m, above 18.5°C measured at 3m.

Cumulative impacts considering the other 2 phases: Because the three phases are located directly adjacent each other, if turbines are placed in areas of bat sensitivity the effect of the impact will be amplified across the entire Hidden Valley site. Since the species of concern are insectivorous and the only major predator of nocturnal flying insects, they contribute significantly to the local ecology. Therefore if significant numbers of bats are killed off insect numbers across the site will elevate as a zone favourable to insects are created across the larger area of the three phases.

Nature: Bat mortalities due to direct blade impact or barotrauma during migration

Migratory routes in the region are completely unknown, and there is no knowledge of whether any such migrations exist. But no known caves capable of providing roosting space for migratory species are known to occur in the area. The migratory species *M. natalensis* have been detected in very low numbers on this phase. However, no bat migrations have been detected and the migratory species are present in very low numbers on the site.

	Without mitigation	**With mitigation**
Extent	Medium (3)	Medium (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (13)**	**Low (11)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

» If migrations occur affected turbines must be relocated on the layout before construction as to avoid impact to the migrating bats, or curtailed accordingly to avoid impact to migrating bats.

Cumulative impacts considering the other 2 phases: If a migratory route are present through all three phases the probability of migrating bats being impacted by turbines are higher than with a single phase. But no migrations have been detected and the migratory species are present in very low numbers on all three phases.

Nature: Destruction of bat roosts during construction Possible roosting spaces on site are mostly in the form of rock crevices where water erosion has exposed rock on hill slopes. Water drainage areas are demarcated in the sensitivity map and turbines are proposed in areas where multiple crevice roosts are unlikely.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (8)**	**Low (8)**
Status (positive or negative)	Negative	Negative
Reversibility	Very low	Very low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » Adhere to the sensitivity map.		
Cumulative impacts considering the other 2 phases: If bat roosts on one phase are destroyed there is a higher probability of artificial or alternative roosts to be repopulated quickly than if bat roosts are destroyed over the larger area of all three phases. This is due to the fact that bats resident in the neighbouring areas will move back faster and repopulate a smaller area faster. However the likelihood of impacting on bat roosts is low.		

7.3.3 Comparative Assessment of Grid Connection Alternatives

There will be no differences in the significance of impacts on bats for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable.

7.3.4. Cumulative impacts

Based on the information available at the time of undertaking this EIA, four wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site and there are other wind projects proposed in the area. Note that currently none of these projects are preferred bidders yet. Mortalities of bats due to multiple wind turbines in an region during foraging and migration can have significant ecological consequences as the bat species at risk are insectivorous and thereby contribute significantly to the control of flying insect at night. On a project specific level insect numbers in a certain habitat can increase if significant numbers of bats are killed off. But if such an impact is present on multiple projects in close vicinity of each other, insect numbers can increase regionally and possibly cause outbreaks of colonies of certain insect species. It is therefore essential that project specific mitigations be applied and adhered to for individual wind energy facilities, as there is it not possible to implement or advocate overarching mitigation on a regional level. Additionally if migrating bats are killed, it can have detrimental effects on the cave ecology of both caves that a specific colony utilises. This is due to the fact that bat guano are the primary form of energy input into a cave ecology system as no sunshine that allows photosynthesis exists in cave ecosystems. Cumulative impacts on bats due to multiple wind energy facilities in the region will be of a medium significance if project specific mitigations being implemented for each project.

7.3.5. Conclusions and Recommendations

The Karusa Phase impact on bats is expected to be low. This statement carries the proviso that if subsequent layout revisions are required these adhere to the sensitivity map. No discoveries on site or in the data have been found that dictates the need to withhold environmental authorisation of the wind energy facility due to potential impacts on bats. It is recommended bat monitoring during the operational phase be carried out for the wind farm and that this is a condition of environmental authorisation.

7.4 Assessment of Potential Impacts on Soil, Land Use, Land Capability and Agricultural Potential

The soil excavations, construction of turbines, buildings, roads and power lines could lead to physical degradation of soil. During the operation of the wind energy facility soil impacts could include soil contamination / soil erosion by vehicles doing maintenance on site.

7.4.1 Impact on the project on Agricultural Potential

The site is located in an arid region of the Northern Cape. The agricultural potential of the Karusa Wind Farm site is very low due to soil and climatic constraints. The low agricultural potential of the site is the result of the dominance of shallow and rocky soils. There are no areas of irrigated agriculture on the site, only grazing of livestock (cattle and sheep). The only soils that are suited to agricultural production are found in the valley bottoms. These will not be impacted by the construction of wind turbines. The areas covered in shallow soils are considered to be suitable only to extensive grazing. This grazing potential is low due to vegetative cover and low biological (biomass) productivity. In addition, the rest of the site which is not occupied by wind turbines and other infrastructure will be able to continue the current land-use i.e. livestock grazing. Therefore the impact of the wind energy facility on agricultural potential of a low significance.

7.4.1.1 Impact Table - Agricultural Potential

Nature of Impact: Loss of land with high agricultural potential and land capability due to the development of the wind energy facility		
	Without mitigation	***With mitigation***
Extent	Low (1) – Site	Low (1) – Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance*	**16 (Low)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Direct impacts cannot be mitigated but indirect impacts can be minimised and avoided through adequate planning of layout	
Mitigation: The loss of agricultural land is a long term loss and there are no mitigation measures that can be put in place to combat this loss. Mitigation is restricted to the limitation of the extent of the impact to the immediate area of impact and minimisation of off-site impacts.		
Cumulative impacts: Soil erosion may arise due to altered surface water runoff. Adequate management and erosion control measures should be implemented.		
Residual Impacts: The loss of agricultural land is a long term loss, however limited an arid are of low agricultural potential and to the footprint of the wind turbine and infrastructure will occupy a minimal percentage of the land, and that agriculture can still continue on the rest of the farm (not occupied by infrastructure for the facility). This loss extends to the post-construction phase albeit of a low to negligible significance.		

7.4.2 Soil Erosion / Degradation during Construction

Soil erodability – the susceptibility of soil to erosion – is a complex variable, not only because it depends on soil chemistry, texture, and characteristics, but because it varies with time and other variables, such as mode of transport (i.e. wind or water). The erodibility of the soils on the site is associated with the sparse vegetation cover, thin soil profiles and steep slopes that characterise it. Soil degradation is the negative alteration of the natural soil profile, usually directly or indirectly related to human activity. Soil degradation due to construction activity will negatively affect soil formation, natural weathering processes, moisture levels and soil stability. This will, in turn, affect biological processes operating in the soil.

Soil degradation includes erosion (i.e. due to water and wind), soil removal, mixing, wetting, compaction, pollution, salinisation, crusting, and acidification.

Soil erosion is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of *inter alia* chemical processes and/or physical transport on the land surface. Soil erosion can be accelerated by human activity is termed “accelerated erosion”.

Erosion of soil due to water run-off is generally considered as more important due to the magnitude of the potential impact over a relatively short period of time which can be very difficult to control. Erosion by water occurs when the force exerted on the soil by flowing water exceeds the internal shear strength of the soil and the soil fails and becomes mobilised into suspension. Erosion potential is typically increased in areas where soil is loosened and vegetation cover is stripped (e.g. construction sites). Erosion sensitivity can be broadly mapped according to the severity of the potential erosion if land disturbing activities occur and this is generally related to the geology, soil types and the topography. Generally speaking, thick accumulations of unconsolidated or partly consolidated fine-grained soils of low plasticity along drainage lines and on moderate to steep slopes or at the base of steep slopes are most vulnerable to severe levels of erosion due to water run-off. These areas are typically called “highly sensitive” areas. Loose soil may also cause dust, relating to access roads and the use of vehicles on the site.

Specifically relating to the site in question, there are steep slopes within the site development footprint (refer to **Figure 7.8),** and the location of turbines on these steep slopes may cause accelerated erosion, in the absence of mitigation measures to prevent soil poison, particularly during construction. If soils are well managed during the construction and operational life of the facility, soil erosion / degradation or loss will not be a significant negative impact.

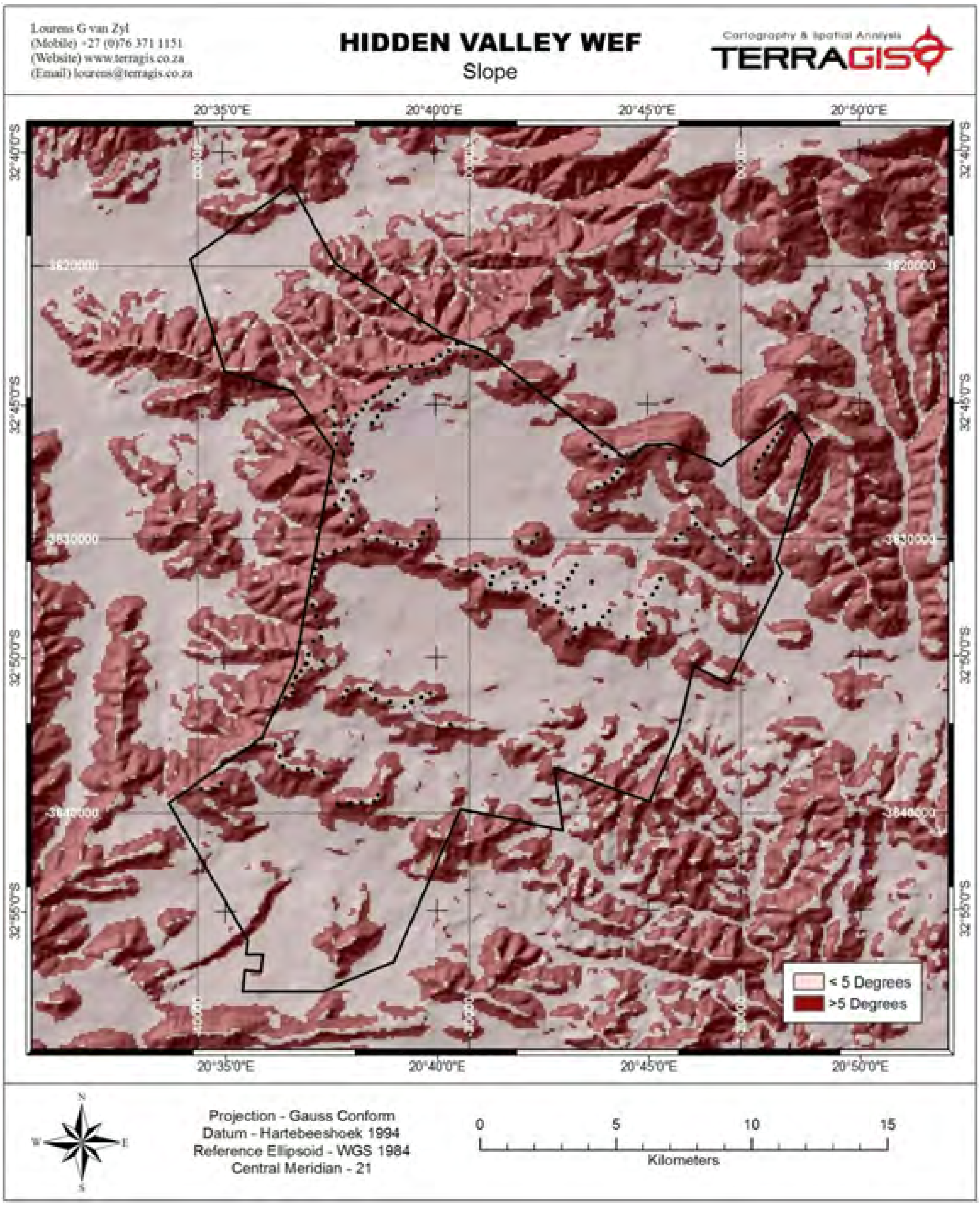

Figure 7.8: Slope map for the Karusa Wind Farm site

7.4.1.1 Impact Table – Soil erosion / degradation during construction

Nature: Soil degradation – Increased erosion due to construction activity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Very short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)

Significance	**Medium (40)**	**Low (18)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, moderate	Yes, minor
Can impacts be mitigated?	Yes	
Mitigation: • Restrict size of authorised disturbance areas. • Minimise activity on steep slopes / the side of slopes. • Implement effective erosion control measures. • Stage construction in phases to minimise exposed ground. • Keep to existing roads, where practical, to minimise impact on undisturbed ground. • Ensure stable slopes of stockpiles/excavations to minimise slumping. • Stockpiles should not exceed 2m in height unless otherwise permitted by the Engineer. • Stockpiles not used in three (3) months after stripping must be seeded to prevent dust and erosion, only if natural seeding does not occur.		
Cumulative impacts: The cumulative impact of soil erosion from all development in the area is considered low if mitigating measures are adhered to.		
Residual impacts: Minor – Localised movement of sediment. Slow regeneration of soil processes		

7.4.3 Soil Contamination / Soil Erosion during the Operation of the facility

During the maintenance activities (operations) of the site, the possibility for soil contamination exists in the event of spillage of oils, fuels or hydrocarbons used for maintenance of the wind turbines, substation or power line. In addition, spillage of fuels from vehicles may occur. These impacts on soil can be mitigated to a low significance.

7.4.3.1 Impact Table – Soil Contamination / Soil Erosion during the Operation of the facility

Nature: Increased pollution of soil by contaminants (e.g. fuel, oil, chemicals, cement).		
	Without mitigation	***With mitigation***
Extent	Local (1)	Local (1)
Duration	Medium term (2)	Very short term (1)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Low (12)**
Status	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Minor
Can impacts be mitigated?	Yes, to a certain extent	
Mitigation:	» Control use and disposal of potential contaminants or hazardous materials. » Remove contaminants and contaminated topsoil and replace topsoil in affected areas.	
Cumulative impacts:	» The cumulative impact of soil pollution is considered low due to the undeveloped nature of the study area.	
Residual impacts:	» Minor negative – slow regeneration of soil processes in and under topsoil	

7.4.4 Comparative Assessment of Grid Connection Options

The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation or power line routing alternatives in terms of impacts of soils or geology.

7.4.5. Cumulative impacts

The development of three projects in a clustered are have to potential to have negative impacts on soil, Soil erosion may arise due to altered surface water runoff. Adequate management and erosion control measures must be implemented. With good soil management, cumulative impacts can be prevented, provided that it is applied to all three development phases and other approved wind projects in the area.

7.4.7 Conclusions and Recommendations

» The proposed development of the Karusa Wind Farm could have negative impacts on soils on the site. The wind energy facility on the site will not have a low impact on the impacts on land use, land capability and agricultural potential of the site (due to the low agricultural potential of the site).

» It is imperative though that adequate stormwater management measures be put in place as the soils on the site are highly prone to erosion due to shallow profiles and steep slopes. The main aspects that have to be managed on the site are:
  - Construction activities, particularly excisions, and access roads. Erosion must be controlled through adequate mitigation and control structures on turbine sites as well as along access routes.
  - Operational activities. Impacts from vehicles, such as spillages of oil and hydrocarbons, should be prevented and mitigated. Implement measures to avoid /reduce chemical spillages during the operation of the facility (such as spill kits).
  - Dust generation on site should be mitigated and minimised as the dust is a social nuisance.

» The following mitigation measures are recommended:
  - Minimise activity in erosion-sensitive areas
  - Implement effective erosion control measures.
  - Use existing roads, where practical, to minimise impact on undisturbed ground.
  - Use slope stabilisation techniques to ensure stable slopes of stockpiles/excavations to minimise slumping.
  - Site management has to be implemented with the appointment of a suitable environmental control officer (ECO) to oversee the process, address problems and recommend and implement corrective measures.
  - Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads).
  - Plan the road and site layout in such a way as to make maximal use of existing roads and fence/border areas to minimise impacts and to keep grazing and natural units as intact as possible.

7.5 Assessment of Potential Social Impacts

7.5.1 Construction - Creation of Employment and Business Opportunities and Opportunity for Skills Development

Construction can lead to direct and indirect social and economic positive impacts on a local and regional scale. The construction of one development phase (such as the Karusa wind farm) is expected to extend over a period of 16-18 months and create approximately 300 construction-related jobs, which have been broken down as follows:

» ~25 % (75) will be available to skilled personnel (engineers, technicians, management and supervisory)
» ~ 15 % (45) to semi-skilled personnel (drivers, equipment operators), and
» ~ 60% (180) to low skilled personnel (construction labourers, security staff).

However, it should be noted that the majority of construction workers, specifically the members from the local community, who are employed during the construction of Phase 1 (Karusa wind farm) are likely to be employed for Phase 2 and 3.

The total wage bill with the construction of the Karusa wind farm (300 employees X 18 months) is estimated to be in the region of R 66 million. This is based on the assumption that the average monthly salary for low, semi and skilled workers is R 5 000, R 12 000 and R 30 000 respectively.

The work associated with the construction phase will be undertaken by contractors and will include the establishment of the access roads and services and the erection of the wind turbines, substations and power line. Members from the local community are likely to be in a position to qualify for the majority of the low skilled and some of the semi-skilled employment opportunities. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local community. Given the high unemployment levels and limited job opportunities in the area this will represent a positive social benefit. The remainder of the semi-skilled and majority of the skilled employment opportunities are likely to be associated with the skilled contactors.

7.5.1.1 Impact Table - Creation of Employment and Business Opportunities during the Construction Phase

Nature: Creation of local employment and business opportunities during the construction phase associated with the wind energy facility.		
	Without Mitigation	**With Enhancement**
Extent	Local – Regional (2) (Rated as 2 due to potential opportunities for local communities and businesses)	Local – Regional (3) (Rated as 3 due to potential opportunities for local communities and businesses)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	***Medium (32)***	***Medium (36)***
Status	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	N/A	N/A
Can impact be enhanced?	Yes	

Mitigation:

» Where feasible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi- and low-skilled job categories.
» Before the construction phase commences the proponent should meet with representatives from the Local Municipality to establish what skills exist in the area and develop a database.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.
» The proponent, in consultation with the Local Municipality, should develop a database of local companies, specifically companies that qualify as Black Economic Empowerment (BEE) companies that qualify as potential service providers prior to the commencement of the tender process for construction contractors.

Cumulative impacts: Opportunity to up-grade and improve skills levels in the area. However, due to relatively small number of local employment opportunities and limited skills range, this benefit is likely to be limited.

Residual impacts: Improved pool of skills and experience in the local area. However, due to relatively small number of local employment and skills-transfer opportunities this benefit is likely to be limited.

7.4.2 Presence of construction workers in the area

The area can be described as a rural area that is sparely populated. In terms of affected farmsteads, there are a relatively small number of farmsteads where people reside that will be directly affected by the proposed project. The findings of the SIA indicate that the farmers in the area are opposed to construction workers being accommodated on the site. The risk posed to farm workers is an issue of concern. There are approximately 19 labourer's that live on the farms affected by the proposed wind energy facility and ~ 15 more on the adjacent farms. These workers are rural, farming folk, Afrikaans speaking people with limited few urban/ life skills and would be vulnerable to impacts associated with the presence of construction workers. In this regard there was an increase in teenage pregnancies and incidence of STDs in Sutherland and the local rural area road when the road between Sutherland and the SALT facility was surfaced. Due to Laingsburg location on the N1, prostitution, STDs, alcohol and drug abuse are existing issues of concern. These issues could be exacerbated by the presence of construction workers.

The potential risk to local residents in the area could potentially be mitigated by implementing a local employment policy, specifically for the low and semi-skilled employment opportunities associated with the construction phase. To perhaps prevent these negative impacts, the towns of Sutherland, Laingsburg and Matjiesfontein are all located within an hour's drive of the site and can be used to accommodate workers. Employing members from the local community to fill the low-skilled job categories would reduce the risk and mitigate the potential impacts on the local communities. These workers will be from the local community and form part of the local family and social network and, as such, the potential impact will be low. However, due to the potential mismatch of skills and low education levels, the potential employment opportunities for the members from these local communities may be low.

ACED has indicated that construction workers will not be accommodated on site and will be transported to and from the site on a daily basis, from Sutherland; Laingsburg or Matjiesfontein. Exposure to farm workers and their families is therefore expected to be minimal. While the risks associated with construction workers at a community level will be low, at an individual and family level they may be significant, especially in the case of contracting a sexually transmitted disease or an unplanned pregnancy. However, given the nature of construction projects it is not possible to totally avoid these potential impacts at an individual or family level.

7.5.2.1 Impact Table – impact of the presence of construction workers in the area on local communities

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers		
	Without Mitigation	***With Mitigation***
Extent	Local (2)	Local (1)
Duration	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc. (5)	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc. (5)
Magnitude	Low for the community as a whole (4)	Low for community as a whole (4)
Probability	Probable (3)	Probable (3)
Significance	***Low for the community as a whole (21)***	***Low for the community as a whole (18)***
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods	
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be eliminated	
Mitigation: » Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi and low-skilled job categories. This will reduce the potential impact that this category of worker could have on local family and social networks; » The proponent and the contractor should develop a Code of Conduct for the construction phase. The code should identify what types of behaviour and activities by construction workers are not permitted. Construction workers that breach the code of good conduct should be dismissed. All dismissals must comply with the South African labour legislation » The proponent and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase; » The movement of construction workers on and off the site, specifically construction workers from outside the area, should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting non-local workers to and from site on a daily basis; » The contractor should make the necessary arrangements for allowing workers from outside the area to return home over weekends and or on a regular basis during the construction phase. This would reduce the risk posed by construction workers from outside the area on local family structures and social networks;		

» It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.
***Cumulative impacts*:** Impacts on family and community relations that may, in some cases, persist for a long period of time. Also in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.
Residual impacts: See cumulative impacts.

7.4.3 Construction - Risk of stock theft, poaching and damage to farm infrastructure

The presence of construction workers on the site increases the potential risk of stock theft and poaching, especially in an area that is sparsely populated and due to the fact that many landowners do not reside on the farms. The movement of construction workers on and off the site also poses a potential threat to farm infrastructure, such as fences and gates, which may also be damaged. Stock and game losses may also result from gates being left open and/or fences being damaged. In this regard, one of the landowners indicated that stock theft, specifically sheep, was a major concern. The landowner indicated that construction workers should not be housed on the site. The potential impacts associated with stock theft can, however, be effectively managed and mitigated, after which the impact significance is rated as low.

7.5.3.1 Impact Table – Stock theft and damage to farm infrastructure

Nature: Potential loss of livestock, poaching and damage to farm infrastructure associated with the presence of construction workers on site		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium **(33)**	Low **(24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock losses etc.	Yes, compensation paid for stock losses etc.
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	Yes
Mitigation: • The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase		

commences; • The proponent should consider developing a Code of Conduct for construction workers. The Code of Conduct should be signed by the proponent and the contractors before the contractors move onto site; • The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below); • The EMPr will outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested; • Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms. • Contractors appointed by the proponent must ensure that construction workers who are found guilty of stealing livestock, poaching and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation; • The housing of construction workers on the site should be limited to security personnel.
***Cumulative impacts*:** None**,** provided losses are compensated for.
Residual impacts: See cumulative impacts.

7.5.4 Increased risk of fires during construction

The presence of construction workers and construction-related activities on the site poses an increased risk of veld fires that in turn pose a threat to the natural fynbos vegetation, farmsteads, livestock and wildlife in the area. In the process, farm and tourism infrastructure may also be damaged or destroyed and human lives threatened. The issue of fire has been raised as a key concern by most farmers in the area, especially runaway fires in the summer months. The use of fire prevention and fire management strategies for the wind energy facility will reduce the risk of fires to a reasonable level.

7.5.4.1 Impact Table – Increased risk of fires

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires		
	Without Mitigation	***With Mitigation***
Extent	Local (4)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)

Significance	Medium **(36)**	Low **(24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock and crop losses etc.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Mitigation:

» The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences.
» Contractor to ensure that open fires on the site for cooking or heating are not allowed except in designated areas.
» Contractor to ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy summer months.
» Contractor to provide adequate fire fighting equipment on-site.
» Contractor to provide fire-fighting training to selected construction staff.
» As per the conditions of the Code of Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire fighting costs borne by farmers and local authorities.
» Use of fire prevention and fire management strategies for the wind energy facility.

Cumulative impacts:

None, provided losses are compensated for.

Residual impacts:

See cumulative impacts.

7.5.5 Impact due to increase in traffic during construction

Road access to the proposed wind energy facility site is likely to be from the N2 and the R345 to Sutherland. Thereafter, access to the site is likely to be via the Komsberg gravel road (P2243), off the tarred R354. Potential social impacts are linked to damage to road surfaces, specifically of the P2443 gravel road, and delays during the actual movement of construction traffic. The movement of heavy construction vehicles during the construction phase has the potential to damage roads and create noise, dust and safety impacts for other road users. The movement of large, heavy vehicles also has the potential to create delays for other road users, specifically local famers and community members.

Several abnormal loads using large trucks will be associated with the construction phase. In addition, crawler cranes (~ 750 t) and assembly cranes may also need to be transported onto and off the site. Other heavy equipment will include normal civil engineering construction equipment such as graders, excavators, cement trucks, etc. If required, ACED will consider the upgrade of the farm gravel roads to the site for the transportation of the wind turbine components during construction. ACED will have to apply for a permit to transport abnormal loads on public roads. In order to avoid traffic congestion and road safety during construction, various mitigation measures and road safety measures can be used.

7.5.5.1 Impact Table – Increase in traffic during construction

<table>
<tr><td colspan="3">Nature: Traffic congestion and associated noise, dust and safety impacts associated with movement of construction related traffic to and from the site on road / private roads.</td></tr>
<tr><td></td><td>Without Mitigation</td><td>With Mitigation</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Local (2)</td></tr>
<tr><td>Duration</td><td>Short term (2)</td><td>Short term (2)</td></tr>
<tr><td>Magnitude</td><td>Low (4)</td><td>Minor (2)</td></tr>
<tr><td>Probability</td><td>Probable (3)</td><td>Probable (3)</td></tr>
<tr><td>Significance</td><td>Low (27)</td><td>Low (18)</td></tr>
<tr><td>Status</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Reversibility</td><td>Yes</td><td></td></tr>
<tr><td>Irreplaceable loss of resources?</td><td>No</td><td>No</td></tr>
<tr><td>Can impact be mitigated?</td><td>Yes</td><td></td></tr>
<tr><td colspan="3">Mitigation:
» The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. This should include includes damage to local roads and internal farm roads. The agreement should be signed before the construction phase commences;
» The proponent and contactor should meet with the local farmers to identify the best time of the day to transport heavy machinery on to the site so as to minimise potential disturbances to other road users;
» The contractor must ensure that damage caused to roads by the construction related activities, including heavy vehicles, is repaired before the completion of the construction phase. The costs associated with the repair should be borne by the proponent;
» Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers;
» All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.</td></tr>
<tr><td colspan="3">Cumulative impacts:
If damage to roads is not repaired then this will impact on the farming activities in the</td></tr>
</table>

area and also result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were not responsible for the damage.
Residual impacts: See cumulative impacts

7.5.6 Damage to and loss of farmland during construction

The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the wind turbines, substations and power lines may damage active farmland. During construction some areas may not be able to be accessed / grazed by the landowner due to construction activities. Furthermore, construction vehicles or personnel could damage farming areas outside of the construction footprint.

The landowner is compensated for leasing of the land by ACED. Where properly planned, the final footprint of disturbance associated with a wind energy facility is small and is linked to the foundation of the individual wind turbines, services roads, substations and power line. The impact on farmland associated with the construction phase can therefore be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase and that construction is limited to the area for the facility, so that farming activities may continue on areas that are not utilised by the wind energy facility. The impact can be reversed, as once construction is complete farming activities may resume on the site.

7.5.6.1 Impact Table – Damage to and loss of farmland during construction

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the wind turbines, sub stations and power lines will damage farmlands and result in a loss of farmlands for future farming activities.		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (1)
Duration	Long term-permanent if disturbed areas are not rehabilitated (5)	Short term if damaged areas are rehabilitated (1)
Magnitude	Moderate (4)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	High **(60)**	Low **(16)**
Status	Negative	Negative
Reversibility	Yes, disturbed areas can be rehabilitated	Yes, disturbed areas can be rehabilitated
Irreplaceable	No, disturbed areas can be	No

loss of resources?	rehabilitated and farming can resume on the properties once the wind energy facility construction is complete	
Can impact be mitigated?	Yes, by compensation	Yes

Mitigation:

- The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. This should include damage to and loss of farm land. The agreement should be signed before the construction phase commences;
- The footprint associated with the construction related activities (access roads, turning circles, construction platforms, workshop etc.) should be minimised;
- All areas disturbed by construction related activities, such as access roads, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase;
- The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed to establish the project. The specifications for the rehabilitation programme should be drawn up the botanical specialist appointed as part of the EIA process;
- The implementation of the Rehabilitation Programme should be monitored by the ECO;
- ACED compensates farmers for leasing of the land for the wind energy facility, which is included in the rental agreement with the local landowners.

Cumulative impacts:
Overall loss of farmland could impact on the livelihoods of the affected farmers, their families and the workers on the farms and their families. However, disturbed areas can be rehabilitated.

***Residual impacts*:** See cumulative impacts.

7.5.7 Operational Phase -Creation of Long- Term employment and business opportunities

Based on information from other wind project, the establishment of a 150MW will create approximately 50 permanent employment opportunities, broken down as follows:

» ~20% (10) will be available to skilled personnel
» ~80% (40) to semi and low skilled personnel.

The operational phase is expected to last 20 years. Members from the local community are likely to be in a position to qualify for the majority of the low skilled and some of the semi-skilled employment opportunities. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local community. Given the high unemployment levels and limited job opportunities in the area this will represent a significant social benefit.

The remainder of the semi-skilled and majority of the skilled employment opportunities are likely to be associated with people from outside the area.

Given the location of the proposed wind energy facility, the majority of permanent staff is likely to reside the local towns in the area, such as Laingsburg, Sutherland and Matjiesfontein. In terms of accommodation options, a percentage of the new permanent employees may purchase houses in one of these towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the annual wage bill earned by permanent staff would be spent in the regional and local economy. This will benefit local businesses in the local towns in the area. The benefits to the local economy will extend over the 2o-year operational lifespan of the project. The local hospitality industry is also likely to benefit from the operational phase. These benefits are associated with site visits by company staff members and other professionals (engineers, technicians etc.) who are involved in the company and the project but who are not linked to the day-to-day operations. The establishment of a Community Trust, as required in terms of the Request for Proposal Document prepared by the Department of Energy, will also create potential benefits for the local community.

7.4.7.1 Impact Table – Creation of Long- Term employment and business opportunities

Nature: Creation of long-term employment and business opportunities associated with the operational phase		
	Without Mitigation	***With Enhancement***
Extent	Local (1)	Local and Regional (4) (Assumes establishment of a Community Trust as indicated below)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)
Significance	Low **(27)**	Moderate **(56)**
Status	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources?	No	
Can impact be enhanced?	Yes	
Enhancement: » ACED to investigate the opportunities for establishing a Community Trust. The revenue for the trust would be derived from the income generated from the sale of energy from the wind energy facility and used to support local IDP projects and initiatives. » The establishment of a Community Trust should be discussed with the Local		

Municipality. » The proponent should implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's and locals employed during the operational phase of the project.
Cumulative impacts: Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities in the area. Creation of revenue stream to fund local projects, thereby enhancing local economic and social development in the area.
Residual impacts: See cumulative impacts

7.5.8 Development of Renewable Energy Infrastructure

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions (Cape Times, 15 November 2007).

The establishment of a clean, renewable energy facility will therefore reduce, albeit minimally, South Africa's reliance on coal-generated energy and the generation of carbon emissions into the atmosphere. The overall contribution to South Africa's total energy requirements of the proposed wind energy facility is relatively small. However, the ~ 150 MW installed capacity will contribute towards offsetting the total carbon emissions associated with energy generation in South Africa. Given South Africa's reliance on Eskom as a power utility, the benefits associated with an IPP based on renewable energy are regarded as significant.

The promotion of renewable energy sources is supported at national and provincial levels. As indicated above the fit with national and provincial energy policies should be viewed within the context of the site's location the potential impact on the areas sense of place and surrounding tourist related land uses. In addition, the current application is not unique. In this regard, a significant number of wind developments are currently proposed in the Northern Cape and other parts of South Africa. The potential contribution of this project should therefore be regarded as valuable, but should not be overestimated / exaggerated.

7.5.8.1 Impact Table – Contribution of the project towards Development of Renewable Energy Infrastructure in South Africa

Nature: Development of infrastructure to generate clean, renewable energy		
	Without Mitigation	**With Mitigation**
Extent	Local, Regional and National (4)	Local, Regional and National (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (56)**	**Medium (56)**
Status	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of resources?	Yes, impact of climate change on ecosystems	
Can impact be mitigated?	Yes	
Enhancement: • Use the project to promote and increase the contribution of renewable energy to the national energy supply; • Implement a skills development and training programme aimed at maximising the number of employment opportunities for local community members; • Investigate the opportunities for establishing a Community Trust that would benefit local, disadvantaged and vulnerable communities.		
Cumulative impacts: Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.		
Residual impacts: See cumulative impacts		

7.5.9 Potential Impact of the wind energy facility on tourism in the region

Tourism in the study area can be described as modest, and is largely associated with the town of Sutherland and the small Victorian rail siding of Matjiesfontein. With regards to Sutherland, the commissioning of the South African largest Telescope (SALT) resulted in a boom in the local tourism sector, specifically in the town of Sutherland. The town currently receives an estimated 15 000 visitors annually. The modest tourism boom has had direct positive knock-on effects on local employment creation and the growth of the local retail sector.

The proposed Karusa site is located ~ 60 km to the south of the SAAO/SALT site and night-time light emissions from warning lights on the turbines may compromise the areas integrity with regard to observations from SALT, depending on the CAA requirements in this regard. This may be exacerbated by other wind projects that may be developed in the area, including the approved Moyeng Suurplaat wind project (400 turbines located ~30km east-north east of site) and proposed G7 Roggeveld wind project (250 turbines located to west of site). Negative impacts on SALT may impact on the day-to-day operations of the observatory and also impact negatively on local tourism industry. However, approval of the Hidden Valley wind project will be contingent on ACED's ability to prove that the facility will not contravene the provisions of the Astronomy Geographic Advantage (AGA) Act (2007).

Other existing tourism initiatives around Sutherland are largely concentrated to the north (towards Calvinia) and west (Ceres) of the town. The area towards the south-east of Sutherland – i.e. the Hidden Valley area – is essentially undeveloped, and does not form part of any of the current tourism development initiatives. However, the activities on the Komsberg Wilderness Nature Reserve (KWNR), located in the Komsberge ~ 5-7 km north of the wind energy facility site, may be negatively impacted. The KWNR is ~12 000 ha in extent, and consists mainly of rehabilitated veld. A number of large mammal species have been reintroduced, including mountain zebra, red hartebeest, gemsbok, and brindled and black wildebeest. A number of scenic lookout points along the Great Escarpment are located in the KWNR. The KWNR currently uses the property primarily for the sake of non-profit conservation (i.e. no public game viewing, hunting, tourism accommodation, etc.). The KWNR offers working holidays on the property, mainly to paying British volunteers who typically come out for periods of 10 days or so. Volunteers stay in the Komsberg farmstead, located on the property (~7 km from nearest proposed turbine location). The experience of the visitors to the KWNR may be negatively impacted by the presence of wind turbines.

In addition, given that there are a number of other wind project proposed in the area the potential benefits to tourism associated with the novelty and scale of the project should not be overstated, and need to be carefully balanced against potential losses of open spaces and scenic vistas. The potential impact on future wilderness-based tourism options also need to be taken into account by the authorities. As indicated above, the impact on the sense of place and the landscape character of the area may be a concern. Findings from studies undertaken in Scotland indicate that there appears to be no clear evidence that tourists would be put off by the presence of wind farms. In this regard far more visitors appeared to associate wind farms with clean energy than with landscape damage, suggesting that they could help to promote Scotland's reputation as an environmentally friendly country as long as they are sensitively sited. This argument could also apply to the South African context. However, the research does note that this could change as more wind projects are built. This applies to the study area and other parts of South Africa.

The impact on tourism is linked to the visual impact on the areas sense of place and landscape character. The findings of the VIA (MetroGIS, March 2012) indicate that the while the area surrounding the site is itself not a major tourist attraction, the R354 is a primary tourism route for visitors to the town of Sutherland and its attractions. The visual impact on the R354 is expected to be of low to moderate negative significance. No mitigation is possible. The findings for the VIA for the Karusa wind farm is that the visual impact will be of a medium significance.

The findings of the Visual Impact Assessment (VIA) (MetroGIS, March 2012) also indicate that the potential for mitigating the impact on the area's sense of place and the landscape is low. In this regard, the Australian National Wind Farm Development Guidelines stress the importance of general location and site selection.

Research in Scotland undertaken by Warren and Birnie (2009) found that there appeared to be no clear evidence that tourists would be put off by the presence of wind farms in tourism areas. In this regard, the research found that far more visitors appeared to associate wind farms with clean energy than with landscape damage, suggesting that they could help to promote an area's reputation as an environmentally friendly area, provided they are sensitively sited. However, the paper notes that this could change as more are built. The key lesson for South Africa is this regard is that wind farms should be located in areas that minimise the potential impact on landscapes and as such also reduce the potential impact on tourism.

7.5.10.1 Impact on tourism industry

Nature: Potential negative impact of the wind energy facility on local tourism		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium **(33)**	Medium **(33)**
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impact be	No	

mitigated?		
Mitigation: In terms of mitigating the visual impacts, it is virtually impossible to hide the facility. The impact on the sense of place of the area cannot therefore be effectively mitigated.		
Cumulative impacts: Potential for fewer tourists to visit the area, and impact on tourist sector (Negative) – however unproven in South Africa		
Residual impacts: See cumulative impacts		

7.5.10 Potential Health Impacts due to the Operation of the wind energy facility

The potential health impacts typically associated wind energy facilities include, noise (discussed as a separate impact in this report), shadow flicker and electromagnetic radiation. The findings of a literature review undertaken by the Australian Health and Medical Research Council published in July 2010 indicate that there is no evidence of wind farms posing a threat to human health. The research also found that wind energy is associated with fewer health effects than other forms of traditional energy generation (WHO, 2004).

Based on these findings it is assumed that the significance of the potential health risks posed by the proposed Karusa Wind Farm is of low significance. The potential noise impacts are covered in the specialist Noise Impact Assessment.

7.5.11 Comparative Assessment of Grid Connection Options

There will be no differences in the significance of social impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a social perspective. No specific preference for substation alternatives are made, as the location of the substation does not directly have any social impacts on any people who reside in or around the site.

7.5.12. Cumulative Social Impacts

Based on the information available at the time of undertaking this EIA, four wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site and there are other wind projects proposed in the area.

Cumulative social impacts include the Karusa wind farm, and the other two development phases, as well as the three other wind projects that are approved in the area include:

» Positive impact from job creation and indirect socio-economic spin-offs.
» Potential cumulative negative visual impacts from several wind projects in the region.

a) <u>Job Creation</u>

Logically, having more than one wind project in this region will have cumulative positive social impact due to job creation during construction and operations. This impact is attempted to be quantified here. It should be noted that the majority of construction workers, specifically the members from the local community, who are employed during the construction of Phase 1 (Karusa Wind Farm) are likely to be employed for Phase 2 and 3. Phase 2 and 3 will therefore not employ an additional 600 workers. For the purposes of the SIA it is assumed that 80% of the workers employed in Phase 1 will be employed during Phase 2 and 3. The total number of construction related employment opportunities associated with all three Phases 1, 2 and 3 will therefore be ~ 420. The total additive wage bill for Phase 1, 2 and 3 will therefore be ~ R 198 million. For the purposes of the SIA it is assumed that the operation of a 450MW site can be undertaken by 100 permanent workers.

b) <u>Visual Impacts</u>

It is obvious, that the overall visual impacts associated with a 450MW wind energy facility will be greater than the visual impacts associated with a 150MW facility. Furthermore having several projects in a region will also have a greater visual impact. Refer to Section 7.5 for more information on visual impacts.

The Australian Wind Farm Development Guidelines (Draft, July 2010) indicate that the cumulative impact of multiple wind farm facilities is likely to become an increasingly important issue for wind farm developments in Australia. This could occur in South Africa. In terms of assessing cumulative impacts, the Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts of wind farms on landscapes, including:

» Combined visibility (whether two or more wind farms will be visible from one location).
» Sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail).
» The visual compatibility of different wind farms in the same vicinity.
» Perceived or actual change in land use across a character type or region.
» Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010).

The potential cumulative impacts are largely linked to the visual impact of the turbines and power lines on the areas sense of place and landscape character. It is obvious, that the overall visual impacts, and hence cumulative impacts, associated with all three development phases (i.e. 450MW project) will be greater than the cumulative impacts associated with a 150MW facility. The cumulative impacts associated with the proposed Hidden Valley project (regardless of size) are exacerbated by the sites location in relation to the approved Moyeng Suurplaat wind project (400 x turbines, 1200 MW), the G7 Roggeveld wind project (250 x turbines, 750 MW) and the approved Konstabel wind project. The potential for cumulative impacts is therefore potentially high. None of the projects in this area have, however, been awarded preferred bidder status at this time.

The issue of Sequential Visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail) is therefore a concern. The potential cumulative impacts are also highlighted by the findings of the VIA (refer to Section 7.6).

In summary, the proposed establishment of three or possibly other wind energy facilities in the area will impact negatively on the landscape and the areas rural sense of place and character.

7.5.14 Conclusions and Recommendations

There will be net positive and negative social impacts from the development of the Karusa Wind Farm. The following is the pertinent recommendations of the SIA, to be included in the EMPr and to be considered by the decision-making authority:

» The establishment of a community trust funded by revenue generated from the sale of energy the project.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» Use of fire prevention and fire management strategies for the wind energy facility, to reduce risks to landowners.

» Negative cumulative social (visual) impacts are a concern due to the number of proposed wind projects in this region of the Northern Cape. The establishment of a number of large wind projects in the area will have a significant impact on the landscape and the areas rural sense of place and character.

The proposed development represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. The cumulative impacts associated with the establishment of a number of proposed wind energy facilities in the area on the local sense of place and landscape cannot be ignored. Likewise the potential employment and community trust related benefits will also increase with the increase in the size of the proposed project.

7.6 Assessment of Potential Visual Impacts

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General. The approach utilised to identify issues related to the visual impact included the following activities:

» The creation of a detailed digital terrain model (DTM) of the potentially affected environment;
» The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.;
» The identification of sensitive environments upon which the proposed facility could have a potential impact;
» The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

The visual character of the sites consists of bands of mountainous terrain, below the escarpment. The site is remote, is an area with small numbers of permanent dwellers. Many of the adjacent landowners do not reside on their farms. This visual character has to a large extent determined the significance of the visual impact on the wind energy facility.

7.6.1 Visual Exposure of Phase 1 – Karusa wind farm

The result of the combined viewshed analyses for the proposed wind energy facility's layout is shown on **Figure 7.9.** The viewshed analysis not only indicates areas from where the wind turbines would be visible (any number of turbines with a minimum of one turbine), but also indicates the potential frequency of visibility (i.e. how many turbines are exposed).

The dark orange areas indicate a high frequency (i.e. 68-74 turbines or parts thereof may be visible) while the yellow areas represent a low frequency (i.e. 1-7 turbines or parts thereof may be visible).

Potential visual exposure as a result of the proposed Karusa Wind Farm extends primarily to the north west of the study area, following the trajectory of the R354 and the Tankwa River valley. Elevated East facing slopes are also exposed. Several residences and homesteads occur along these east facing slopes. Moderate exposure is expected in these areas.

Visual exposure to the north is interrupted by high ridgelines lying approximately 5km north of the site. While exposure is medium to high, very few residences or farmsteads are present in this zone. There is some spill over of low to moderate visual exposure onto south facing slopes between 10- 15km to the north with several residences and homesteads potentially affected.

The far north of the study area is visually screened by the mountain range.

In the south, the extent of potential visual exposure is limited to less than 10km by east-west orientated ridgelines. The elevation decreases to the south of the site resulting in low to moderate potential visual exposure being limited to the very crests of north facing ridges between 10 and 20km to the south. There are very few settlements to the south of the site with the majority of these not expected to be visually impacted.

The highest frequency of potential visual exposure is centred on the site itself. The settlement of De Hoop falls within the site and up to 74 turbines may be visible from within these areas, due to the elevated location of the proposed turbines.

Visual exposure to the east within a 5km radius is moderate to high. Several settlements are present. Beyond 5km visual exposure is low to moderate and limited to elevated west facing slopes. Settlements do occur to the east; however the majority of these are along the valley floors and will be unaffected.

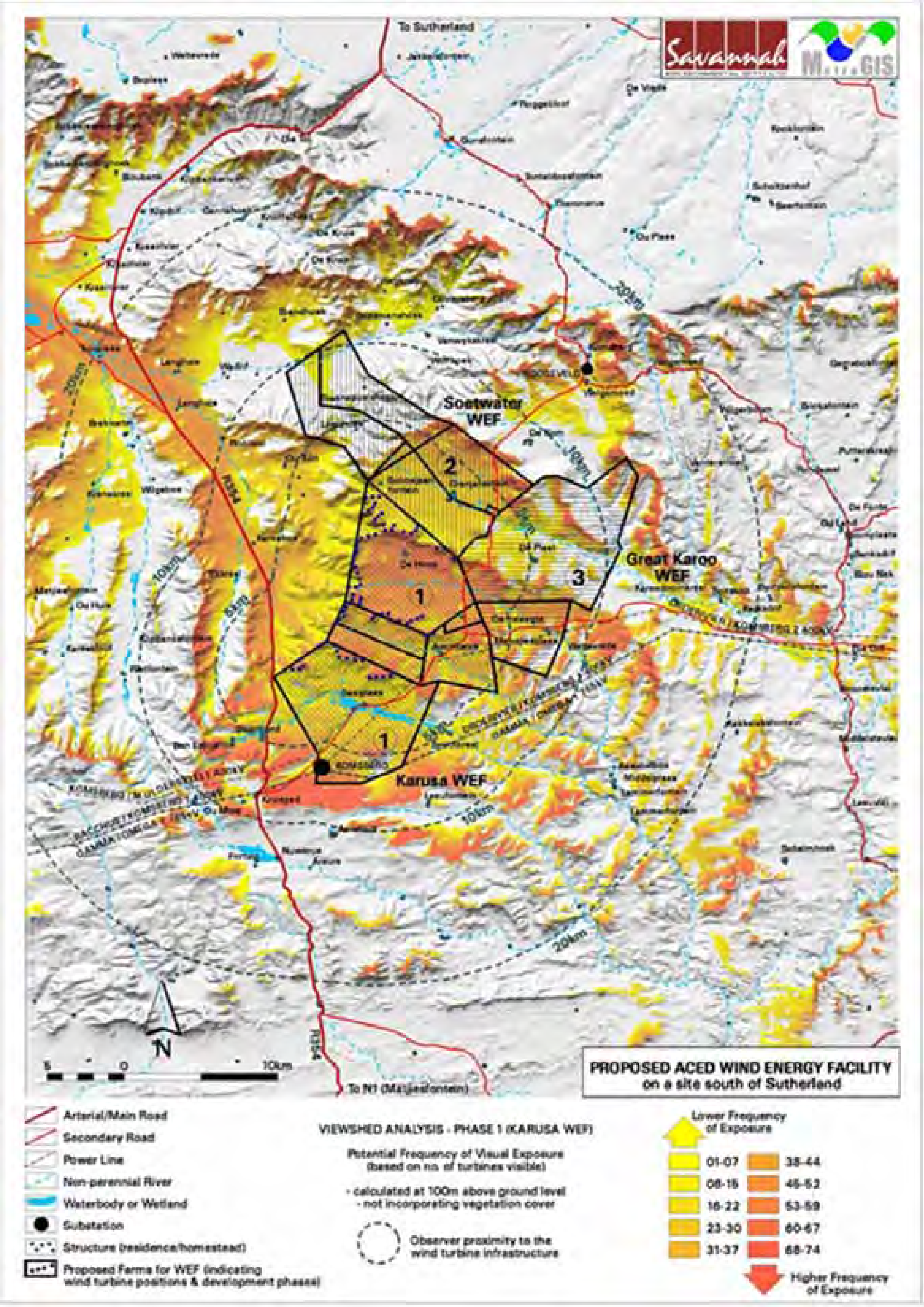

Figure 7.9: Viewshed Analysis of the proposed Karusa Wind Farm

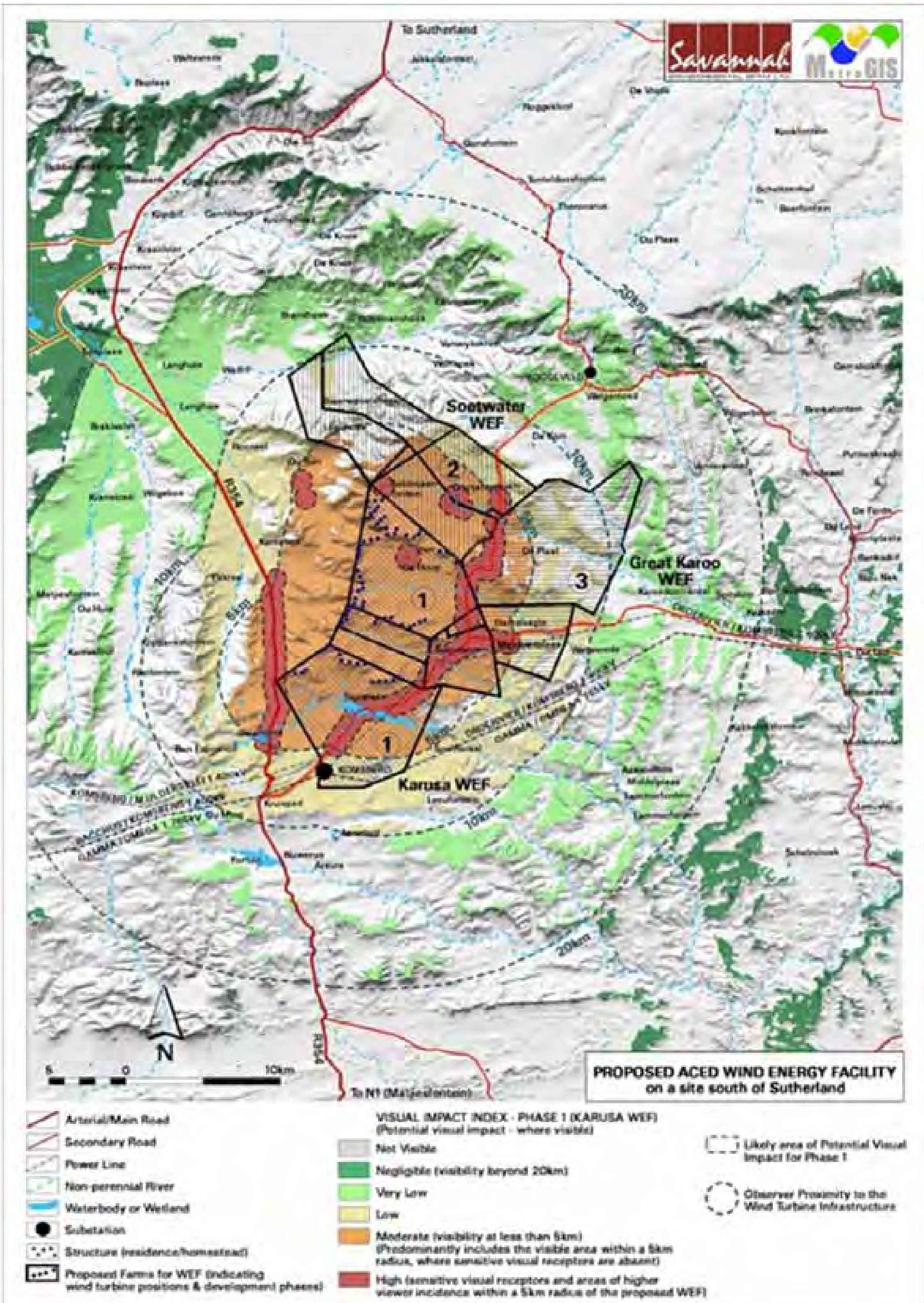

Figure 7.10: Visual impact index of Phase 1 (Karusa Wind Farm) of the proposed Hidden Valley wind energy facility.

The topography and the placement of the wind turbines on the high ground influence the frequency of exposure. The following is of relevance:

» Potential areas of high visual impact within this 5km radius include a stretch of the R354 road to the west and a section of the secondary road between the Komsberg Substation and the Roggeveld Substation. Some settlements and homesteads also fall within this 5km radius. These receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 74 turbines). Specific homesteads and settlements include the following:
  - Ou Tuin;
  - Bobbejaansfontein;
  - Oranjefontein;
  - De Hoop;
  - Meitjiesplaas;
  - Avondrus;
  - Saaiplaas;

» The **extent of potential visual impact is Low between the 5km and 10km radius**, while the hilly topography results in large visually screened patches in north and west, with smaller visually screened areas to the east and south. Areas of potentially moderate visual impact are restricted to roads and only a few settlements.

» A stretch of the R354 in the west, as well as discontinuous stretches of all the secondary roads south, east and north of the site will be exposed to potentially moderate visual impact, as will a number of homesteads and settlements. These receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 74 turbines). Homesteads and settlements include the following:
  - De Plaat;
  - Damslaagte;
  - Smithkraal;
  - Leeufontein;
  - Kruispad;
  - Bon Espirance;
  - Kareebos;
  - Outuin;
  - Rooiwal.

» Beyond the 10km radius (but within the 20km radius), the extent of potential visual impact decreases quite markedly, with visually exposed areas located mainly in the north west, north east and south west. The magnitude of visual impact in the visually exposed areas is reduced to very low.

» Large areas north of this zone are visually screened by the undulating topography. Sensitive visual receptors likely to be exposed to high frequencies of visual exposure include a section of the R354 and secondary road to the north west of the site, and limited discontinuous stretches of secondary roads to the east and north east. These receptors are likely to experience low visual impact. A number of settlements and homesteads are likely to experience a similar impact. These are located primarily in the north and north west of the zone. Affected homesteads and settlements include the following:

- o Kranskraal;
- o Brakwater;
- o Langhuis;
- o TuinPlaas;
- o Brandhoek;
- o Wegkruip;
- o Welgemoed

» In the longer distance (i.e. beyond the 20km radius), visual exposure is further reduced in both extent and magnitude. Visual impacts are likely to be negligible. Visual receptors include the area to the north west along the Tankwa river Valley and elevated ridges to the east and south east.

7.6.1.1 Photo Simulations

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the wind energy within the receiving environment. Refer to Visual Assessment (Appendix I) for the remainder of the photo-simulations. Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the proposed wind energy facility within the receiving environment. The purpose of the photo simulation exercise is to support the findings of the VIA, and is not an exercise to illustrate what the facility will look like from all directions.

The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility. The simulations are based on the wind turbine dimensions and layout as indicated on **Figure 7.11 and Figure 7.12.** Each photographic simulation is preceded by a panoramic overview of the landscape from the specified viewpoint being discussed. The panoramic overview allows for a more realistic viewer scale that would be representative of the distance over which the turbines are viewed. Where relevant, each panoramic overview indicates the section that was enlarged to show a more detailed view of the wind energy facility. The simulated wind turbines, as shown on the photographs, were adapted to the atmospheric conditions present when the original photographs were taken. This implies that factors such as haze and solar glare were also simulated in order to realistically represent the observer's potential view of the facility.

Figure 7.11.: Photo simulation of the possible view of the wind turbines from the R354 road

Viewpoint 1 is located on the arterial R354 to the west of the proposed wind energy facility. The point is located approximately 5km away from the closest turbine of the Karusa wind energy facility. The viewing direction is easterly and is representative of a short distance view that residents of local homesteads and visitors to the area will experience while travelling this road between Sutherland and Matjiesfontein. Approximately 35 turbines are fully or partially visible in the landscape.

Figure 7.12.: Photo simulation of the possible view of the wind turbines from the secondary road that traverses the site

Viewpoint 3 is located on the secondary road which traverses the proposed Hidden Valley wind energy facility, running from the R354 in the south west to the Roggeveld Substation to the north east of the site. The point is located on the boundary of the proposed Soetwater Wind Farm site approximately less than 1km away from the closest turbine. The viewing direction is south westerly and is representative of a short distance view that residents of local homesteads and visitors to the area will experience while travelling along this secondary road. Approximately ***95*** *turbines are fully or partially visible in the landscape*.

7.6.1.2 Impact Table - visual impact on residents of settlements and homesteads within 5 km from the site

Nature: Potential visual impact on residents of settlements and homesteads in close within 5 km from the site		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/A
Duration	Long term **(4)**	N/A
Magnitude	Low (4)	N/A
Probability	Highly Probable (4)	N/A
Significance	**Medium (48)**	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Recoverable **(3)**	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	No	N/A
Mitigation: None.		
Cumulative impacts: The construction of up to 74 wind turbines will increase the cumulative visual impact within the region.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

7.6.2 Change of visual character and sense of place of the region

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.) play a significant role. A visual impact on the "sense of place" is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

Specific aspects contributing to the sense of place of this region include the pastoral visual quality of the farmland and the scenic beauty of the coastline and of the mountains inland. The anticipated visual impact of the facility on the regional visual character, and by implication, on the sense of place, is expected to be moderate. There is no mitigation for this impact.

7.6.2.1 Impact Table - visual character and sense of place

Nature of Impact: Potential visual impact on the visual character and sense of place of the region.		
	No mitigation	***Mitigation Considered***
Extent	Regional **(3)**	N/A
Duration	Long term **(4)**	N/A
Magnitude	Moderate **(6)**	N/A
Probability	Probable **(3)**	N/A
Significance	Moderate **(39)**	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Recoverable **(3)**	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	No	N/A
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of up to 74 wind turbines will increase the cumulative visual impact within the region.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

7.6.3. Lighting Impacts

The area immediately surrounding the proposed facility has a relatively low incidence of receptors and light sources, so light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The wind energy facility may contribute to the effect of sky glow in an otherwise dark environment. Lighting impacts will be moderate significance both before and after mitigation.

The SALT is situated at the South African Astronomical Observatory (SAAO) field station 14km east of the town of Sutherland. This site, in the arid Karoo region, was established in the early 1970's and was chosen for its dark and clear skies and good weather conditions. The site is 35km to the north east of the proposed wind energy facility and lies on an elevated plateau. The SALT lies on the plateau at an elevation of 1755m ASL. The highest turbine elevations are expected to be at approximately 1500m ASL (height of hub of most elevated turbines).

While light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity, it is not possible to see these lights from the SALT due to elevated topography which limits visibility to 10km to the north east.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low. The furthest extent of direct visibility of turbine hubs and lights in the direction (NE) of the SALT is 10km.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow. This impact is the only light impact with the potential to affect the SALT.

The intensity of light generated by the wind energy facility is expected to be of a lower order than that generated by the urban area of Sutherland due to the dispersed nature of the turbines. The distance of the SALT from the wind energy facility and the elevated position of the SALT reduce the significance of this impact to insignificant.

7.6.3.1 Impact Table - Significance of visual impact of lighting at night on visual receptors in close proximity to the proposed wind energy facility

Nature of Impact: Potential visual impact on of lighting at night on visual receptors in close proximity to the proposed wind energy facility.

	No mitigation	**Mitigation considered**
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Low **(4)**
Probability	Probable **(3)**	Probable **(3)**
Significance	Moderate **(42)**	Moderate **(36)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	N/a
Mitigation: Planning: mounting aircraft warning on the turbines representing the outer perimeter of the facility. Planning: pro-active lighting design and planning. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of 77 wind turbines with their aircraft warning lights will increase the cumulative visual impact of such warning lights within the region. This is specifically relevant in context of the two projects near the Karusa Wind Farm which have been authorised by DEA.		
Residual impacts: None. The visual impact of lighting will be removed after decommissioning and the removal of the wind turbines.		

7.6.4. Shadow flicker

Shadow flicker occurs when the sky is clear, and when the rotor blades are between the sun and the receptor (i.e. when the sun is low). De Gryse in Scenic Landscape Architecture (2006) found that “most shadow impact is associated with 3-4 times the height of the object”. Based on this research, a 500m buffer along the edge of the facility is submitted as the zone within which there is a risk of shadow flicker occurring. In this respect, inhabited settlements and homesteads within the site, as well as those within 500m of the property boundary may experience a visual impact of low significance both before and after mitigation.

Shadow flicker only becomes an issue if a wind turbine is in close proximity to houses / dwelling. To avoid shadow flicker, ACED to put in a turbine separation distances to avoid shadow flicker. Taking into account site constraints ACED should use a minimum spacing of 5 rotor diameters (approximately 560m) based on our maximum turbine envelope in the prevailing (bi-directional east west) wind directions, 3 rotor diameters (approximately 336m) for non-predominant.

7.6.6.1 Impact Table - Significance of visual impact of shadow flicker

Nature of Impact: Potential visual impact of shadow flicker on visual receptors in close proximity to the proposed wind energy facility.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(1)**
Significance	Low **(24)**	Low **(12)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	N/a
Mitigation: Planning: ensure that all wind turbines are 500m or further from the nearest inhabited homestead of settlement. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: None.		
Residual impacts: None. The visual impact of shadow flicker will be removed after decommissioning and the removal of the wind turbines.		

7.6.6. The potential to mitigate visual impacts

It is not possible to mitigate the primary visual impact, namely the appearance of the wind energy facility (the wind turbines). The functional design of the turbines cannot be changed in order to reduce visual impacts. Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*". Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact. The overall potential for mitigation is generally low or non-existent. Mitigation of visual impacts associated with the construction of roads includes the use of existing roads wherever possible.

Where new roads are required, these should be planned taking due cognisance of the topography. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems. Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning. It is recommended that the substation design makes use of low profile construction technology to mitigate visual impact on the surrounding area.

The Civil Aviation Authority (CAA) prescribes that aircraft warning lights be mounted on the turbines. However, it is possible to mount these lights on the turbines representing the outer perimeter of the facility. In this manner, fewer warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact. The regulations for the CAA's *Marking of Obstacles* should be strictly adhered to, as the failure of complying with these guidelines may result in the developer being required to fit additional light fixtures at closer intervals thereby aggravating the visual impact.

Mitigation of other lighting impacts includes the pro-active design, planning and specification lighting for the facility by a lighting engineer. The correct specification and placement of lighting and light fixtures for the turbines and the ancillary infrastructure will go far to contain rather than spread the light. Additional measures include the following:

» Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
» Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights;
» Making use of minimum lumen or wattage in fixtures;
» Making use of down-lighters, or shielded fixtures;
» Making use of Low Pressure Sodium lighting or other types of low impact lighting.
» Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

Mitigation of potential shadow flicker impacts includes ensuring that all wind turbines are located 500m or further from the nearest inhabited homestead of settlement. Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of the construction site. Construction should be managed according to the following principles:

» Reduce the construction period through careful planning and productive implementation of resources.
» Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing.
» Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.

» Ensure that rubble, litter and disused construction materials are managed and removed regularly.
» Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way
» Reduce and control construction dust through the use of approved dust suppression techniques.
» Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
» Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.
» Secondary impacts anticipated as a result of the proposed wind energy facility (i.e. visual character and sense of place) are not possible to mitigate.
» There is no mitigation to ameliorate the negative visual impacts on tourist routes, destinations and potential of the region.
» Once the wind energy facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated.

The possible mitigation of both primary and secondary visual impacts as listed above should be implemented and maintained on an on-going basis.

7.6.7. Cumulative impacts

Figure 7.13 shows the potential cumulative visual exposure of the three development phases (the Karusa Wind Farm, and Phase 2 and Phase 3). The cumulative visual impact is highest within a 5km radius of the turbine infrastructure. This impact moderates with distance. Slopes that have aspects that face the wind energy facility experience very high visual impact. There are several visually screened patches towards the eastern periphery of this zone. 15 settlements that will experience visual impact fall within this zone. 11 of these settlements potentially experience a very high visual impact. These are further categorised in terms of intensity of visual impacts.

Potential areas of high intensity visual impact (3 phases visible) within this 5km radius include a stretch the secondary road running north-south through the centre of the wind energy facility and two settlements located centrally within the wind energy facility, namely:

» De Hoop;
» Oranjefontein.

Areas of high intensity visual impact (3 phase visible) are restricted to within the footprint of the wind energy facility.

Potential areas of moderate intensity visual impact (2 phases visible) within this 5km radius include a stretch the secondary road running north from the northern periphery of the wind energy facility towards the Roggeveld substation and a short stretch of secondary road west of Meintjiesplaas. Five settlements are identified as having a moderate intensity visual impact within this zone, namely:

» Meintjiesplaas;
» De Plaat;
» Bobbejaanfontein;
» De Kom;
» Ou Tuin.

A stretch of the R354 in the west, as well as discontinuous stretches of secondary roads to the south and east of the site, will be exposed to potentially moderate visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to higher frequencies of visual exposure.

Based on the information available at the time of undertaking this EIA, four wind energy facilities have an environmental authorisation occur in close proximity to the Hidden Valley site.

Cumulative visual impacts include the Karusa Wind Farm, and the other two development phases, as well as the three other wind projects that are approved in the area include. This would imply an incremental increased in visual impact in this region of the Karoo. On the other hand, from a visual perspective, the overlapping viewshed may be favourable, as it represents the consolidation and concentration of potential visual impacts within a clustered zone of 15-20 km.

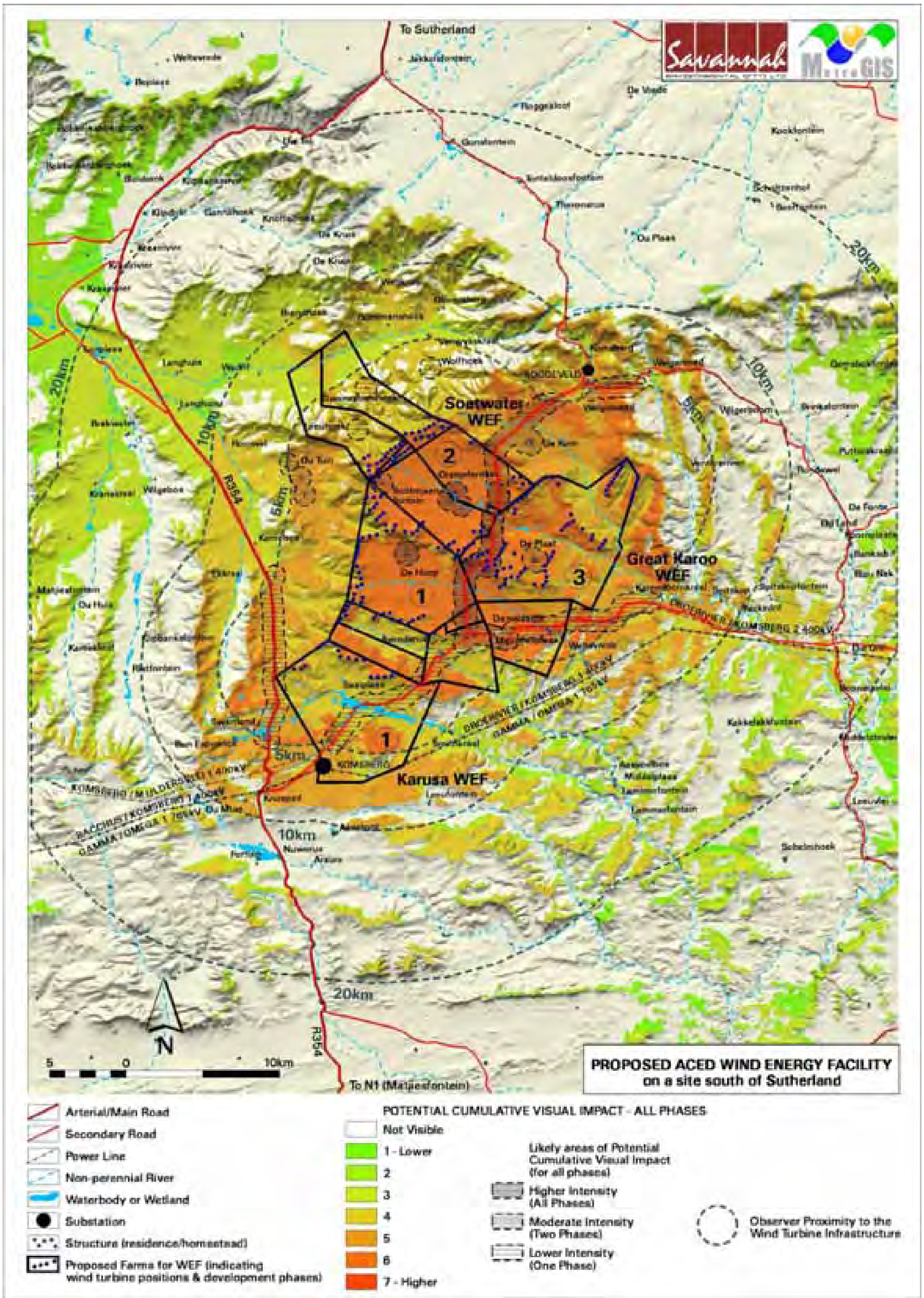

Figure 7.13: Cumulative Visibility analyses (for the three development Phases of the Hidden Valley project).

7.6.8. Comparative Assessment of Grid Connection Options

There will be no differences in the significance of visual impacts for any of the alternative substation or power line routings. This is because the region in which the site is located is sparsely populated, with large distances between one homestead and the next. Furthermore, the visual landscape is already disturbed with the current 400 kV substation on the site as well as power lines, which the substation will be located next to. Therefore any of the proposed alternatives are considered acceptable from a visual impact perspective.

7.6.9. Conclusions and Recommendations

The construction and operation of the proposed Karusa Wind Energy Facility and its associated infrastructure will have a visual impact on the visual environment especially within, but not limited to, the area within 8km of the proposed facility. Beyond this visual impact is reduced by the screening effects of the rugged topography and the contained nature of the site. The exception to this is a corridor of visual intrusion up the Tankwa River valley, however there are very few visual receptors in this area.

The low density of visual receptors in the study area results in a low intensity of visual impact, however the significance of the impacts is moderate to high as a result of undeveloped character of the landscape.

The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants.

However, these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements and tourists passing through or holidaying in the region.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development. The character of the site will be altered by the presence of the wind energy facility.

A number of mitigation measures have been proposed in the visual report, which, if implemented and maintained, will reduce the significance of the certain visual impacts associated with the proposed wind energy facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. The anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent.

As such, the facility would be considered to be acceptable from a visual perspective.

7.7 Assessment of Potential Noise Impacts

7.7.1 Relevant Noise Receptors

There are no residential communities close to the proposed development. The study area has a rural character in terms of the background sound levels. Potentially Sensitive Receptors (PSRs), also known as Noise-Sensitive Developments (NSDs) were initially identified using Google Earth®, supported by a site visit to confirm the status of the identified dwellings.

The reason for the site visit, apart from sampling ambient sound levels, is that there could be a number of derelict or abandoned dwellings that could be seen as a sensitive receptor, or small dwellings that could not be identified on the aerial image, or those that were built after the date of the aerial photograph.

Potential receptors in and around the proposed wind energy facility were identified and are presented in **Figure 7.14**. The locations of the PSRs are defined in the Noise study (**Appendix L**).

It should be noted that, apart from NSD07, no other NSD are situated closer than 1,200 meters from the closest wind turbines relevant for Karusa Wind Farm (and all three phases of the development). It should be noted that NSD05, 06 and 10 are derelict buildings, and not considered NSDs.

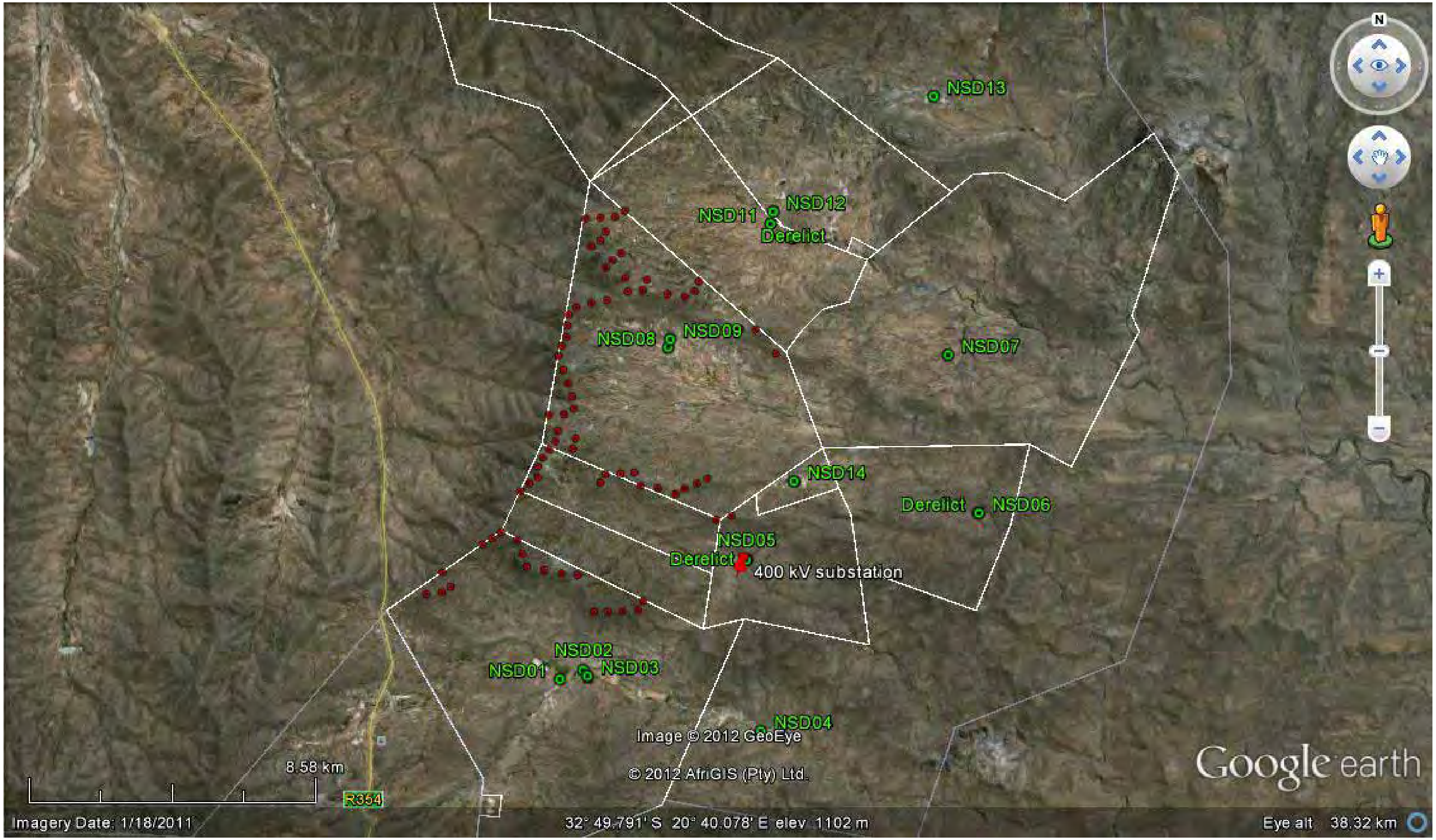

Figure 7.14: Aerial image indicating potential noise sensitive receptors and property boundaries for the Karusa Wind Farm

7.7.2 Noise from Construction activities

Noise sources during construction include the following:

» **Construction equipment**
Construction equipment likely to be required will typically include excavator/graders, bulldozers, dump trucks, vibratory roller, bucket loader, rock breaker(s), drill rig, flat-bed truck(s), pile drivers, concrete trucks, cranes, fork lift(s) and various 4WD and service vehicles. Octave sound power levels typical for this equipment are presented in the Noise report.

» **Blasting**
Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. However, blasting will not be considered during the EIA phase for the following reasons:
  * Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use the minimum explosives and will occur in a controlled manner. The breaking of obstacles with explosives is also a specialized field and when correct techniques are used, causes significantly less noise than using a rock-breaker.
  * People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. However, these are normally associated with close proximity mining/quarrying.
  * Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties generally receive sufficient notice (siren) and the knowledge that the duration of the siren noise as well as the blast will be over relative fast results in a higher acceptance of the noise. Note that with the selection of explosives and blasting methods, noise levels from blasting is relatively easy to control

» **Traffic due to construction vehicles**
A source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the wind turbine. Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to additional traffic will be estimated using the methods stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise).

7.7.2.1 Results of Noise Modelling – Construction Noise

Only the calculated day time ambient noise levels are presented, as construction activities that might impact on sensitive receptors should be limited to the 06:00 – 22:00 time period. The worst-case scenario is presented with the entire activities taking place simultaneously during wind-still conditions, in good sound propagation conditions (20^{o}C and 80% humidity).

Even though construction activities are projected to take place only during day time, it might be required at times that construction activities take place during the night (particularly for a large project). Below is a list (and reasons) of construction activities that might occur during night time:

» Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
» Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore it is hard to judge beforehand if a construction team would be required to work late at night.

As it is unknown where the different activities may take place, it was selected to model the impact of the noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise impact) at all locations where wind turbines may be erected, calculating how this may impact on potential noise-sensitive developments as well as mapping this modelled construction activity over distance. Noise created due to linear activities (roads) were also evaluated and plotted against distance as illustrated below.

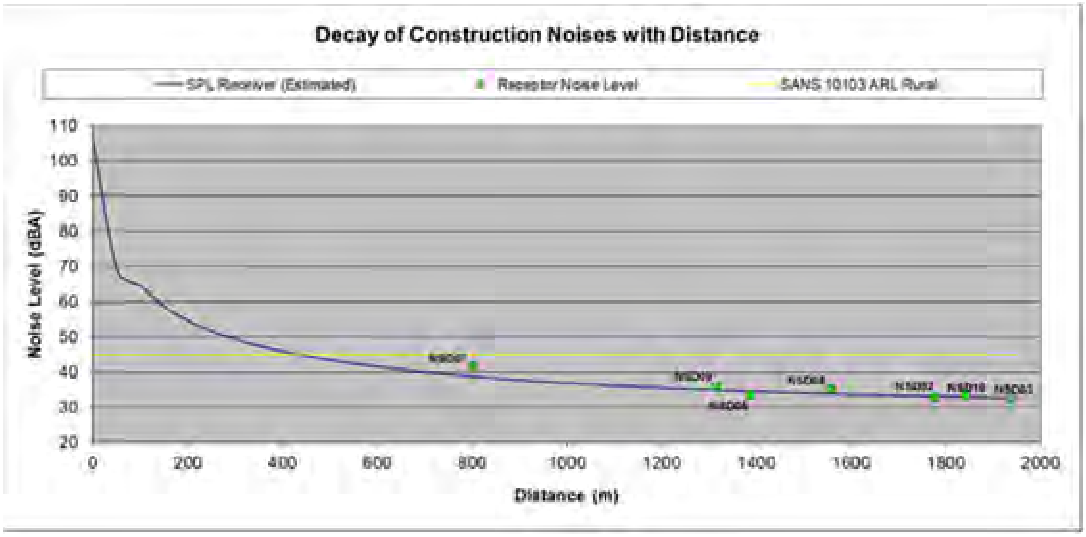

Figure 7.15: Construction noise: Projected Construction Noise Levels as distances increase between NSDs and locations where construction can take place

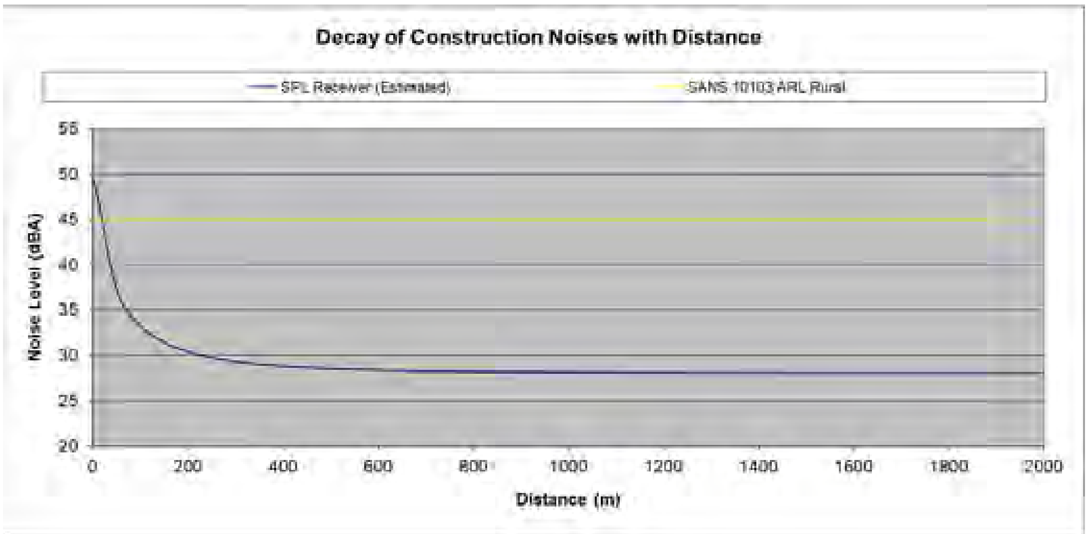

Figure 7.16: Construction noise: Projected Road Traffic Noise Levels as distances increase between NSDs and access roads (5 LDV and 5x Trucks travelling at 50 km/hr on a gravel road)

7.7.2.2 Impact tables summarising the significance of noise impacts (with and without mitigation) during Construction

Nature: Numerous simultaneous construction activities that could impact on PSRs.	
Acceptable Rating Level	Rural district with little road traffic: 45 dBA outside during day. Us of $L_{Req,d}$ of 45 dBA for rural areas.
Extent ($\Delta L_{Aeq,d}$>7dBA)	**Regional** – Change in ambient sound levels would extend further than 1,000 meters from activity **(3).**
Duration	**Temporary –** *Noisy activities in the vicinity of the receptors would last a portion of the construction period* **(1).**
Magnitude	**Low (2).**
Probability	**Improbable (1).**
Significance	**Low (10)**
Status	Negative.
Reversibility	High
Irreplaceable loss of resources?	Not relevant.
Can impacts be mitigated?	Yes, though mitigation not required.
Mitigation:	The following mitigation may be used: » Ensure a good working relationship between the developer and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potential sensitive receptor(s) include: o Proposed working times; o how long the activity is anticipated to take place; o what is being done, or why the activity is taking place; o contact details of a responsible person where any complaints can be lodged should there be an issue of concern. » When working near (within 500 meters – potential construction of access roads and trenches) to a potential sensitive receptor(s), limit the number of simultaneous activities to the minimum as far as possible; » When working near to potentially sensitive receptors, coordinate the working time with periods when the receptors are not at home where possible. » Potential receptors are most likely at school or at work, minimizing the probability of an impact happening; » Normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening. » Technical solutions to reduce the noise impact during the construction phase include: o Using the smallest/quietest equipment for the

	particular purpose. For modelling purposes the noise emission characteristics of large earth-moving equipment (typically of mining operations) were used, that would most likely over-estimate the noise levels. The use of smaller equipment therefore would have a significantly lower noise impact; o Ensuring that equipment is well-maintained and fitted with the correct and appropriate noise abatement measures.
Cumulative impacts:	This impact is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area.
Residual Impacts:	This impact will only disappear once construction activities cease.

7.7.3 Noise Sources: Operational Phase

Noise emitted by wind turbines can be associated with two types of noise sources:

- Aerodynamic sources: due to the passage of air over the wind turbine blades; and
- Mechanical sources that are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc. These sources generally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the substations themselves, traffic (maintenance) as well as transmission line noise.

- **Noise from the Wind Turbines: Aerodynamic sources17**

  Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:
  - Self noise due to the interaction of the turbulent boundary layer with the blade trailing edge
  - Noise due to inflow turbulence (turbulence in the wind interacting with the blades)
  - Discrete frequency noise due to trailing edge thickness
  - Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade)
  - Noise generated by the rotor tips

These types of noise are discussed in more detail in the Noise Impact Assessment report contained in Appendix L.

[17] *Renewable Energy Research Laboratory, 2006; ETSU R97: 1996*

7.7.5.1 Results of Noise Modelling – Operational Phase for Karusa Wind Farm

The Noise study focuses on the impacts on the surrounding sound environment during times when a quiet environment is highly desirable. Noise limits are therefore appropriate for the most noise-sensitive activity, such as sleeping, or areas used for relaxation or other activities (places of worship, school, etc.).

Appropriate Zone Sound Levels are therefore important, yet it has been shown that the SANS recommended (fixed) Night Rating Level ($L_{Req,N}$ = 35dBA) might be inappropriate due to the increased ambient sounds relating to wind action. A more appropriate method to determine the potential noise impact would be to make use of the projected noise levels due to the operation of the wind energy facility as well as the likely ambient sound levels due to wind induced noises.

Based on the preceding figures it is obvious that the risk of a noise impact developing is very low. The operation of the Karusa Wind Farm will not have a noise impact on any of the current noise-sensitive developments.

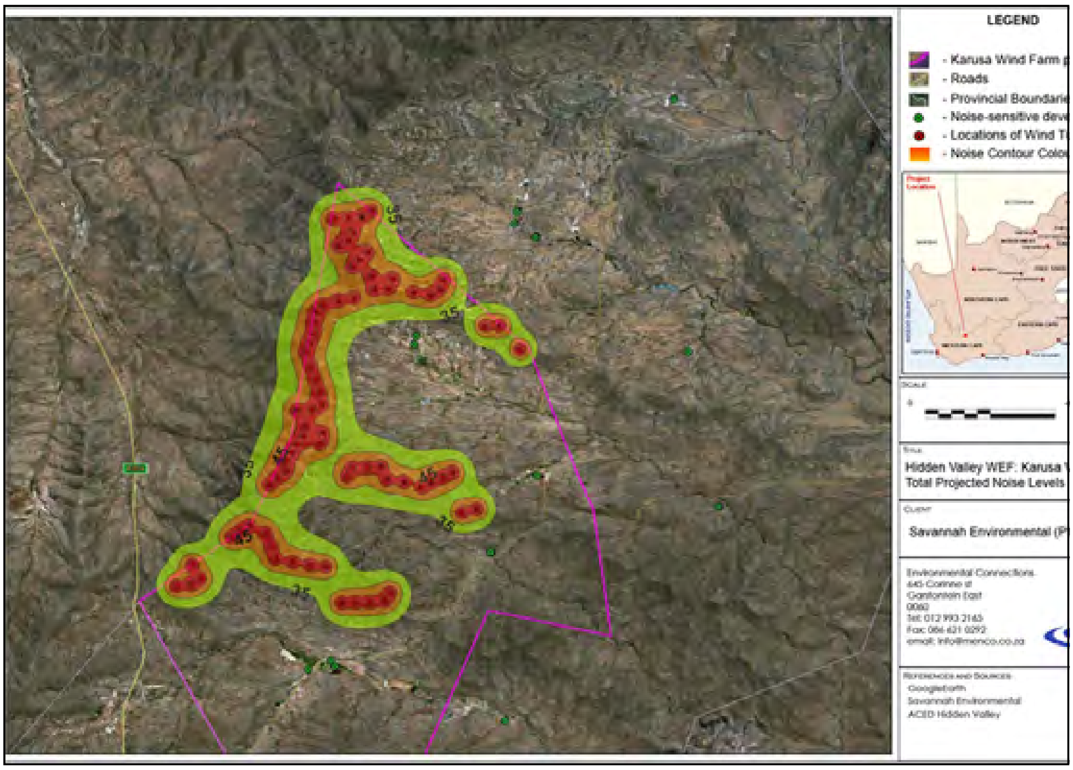

Figure 7.17: Projected Noise Levels (ISO model) from Karusa wind turbines; Contours of constant sound levels for a 5 m/s wind (WTGs marked as red dots, PSRs as green dots)

The change in ambient sound levels is illustrated in **Figure 7.18.**

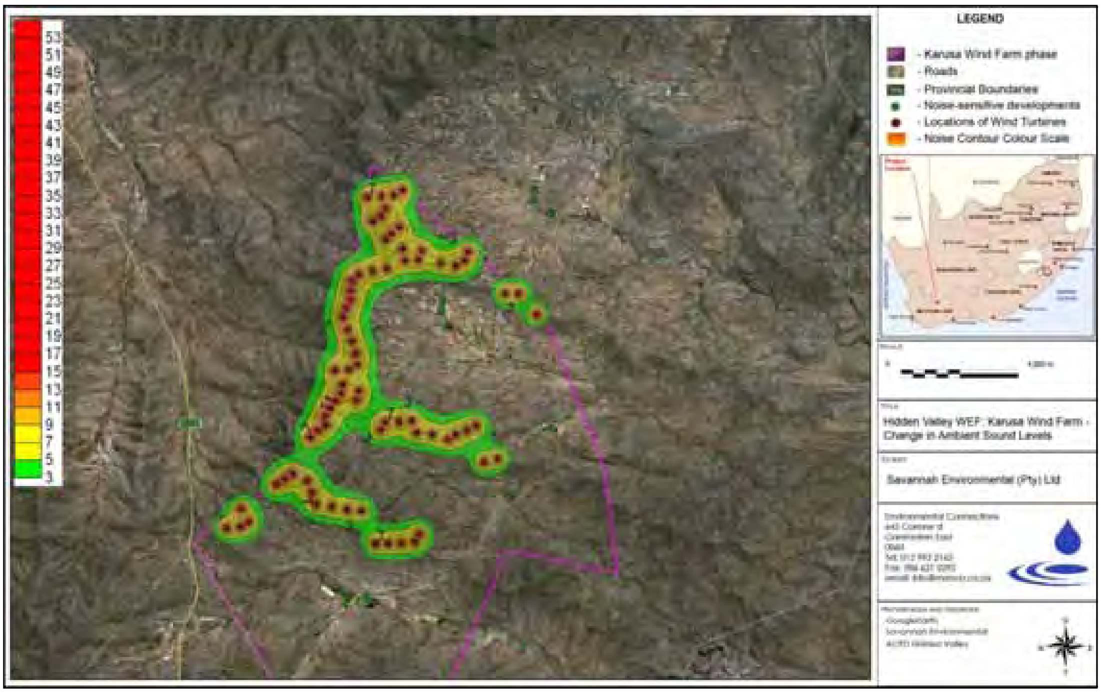

Figure 7.18 Change in ambient sound levels (ISO model), contours of constant noise levels for a 5 m/s wind (turbines marked as red dots, NSDs as green dots)

7.7.5.2 Impact tables summarising the significance of noise impacts (with and without mitigation) from the wind turbines – operational phase

Nature: Numerous turbines operating simultaneously during a period when a quiet environment is desirable.	
Acceptable Rating Level	Rural district with little road traffic. Refer to **Error! Reference source not found.** for the proposed Night Rating Level that varies with wind speed.
Extent ($\Delta L_{Aeq,n}$>7dBA)	Local – Impact will extend less than 1,000 meters from activity. (2).
Duration	Long – Facility will operate for a number of years (4).
Magnitude	Low (2) – for all current NSD
Probability	Improbable (1) for all current NSD
Significance	***8 (Low) for all current NSD using the Vestas V90 3.0 MW turbine***
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Can impacts be mitigated?	No noise impact, mitigation not required
Mitigation:	No mitigation required.
Cumulative impacts:	This impact is cumulative with existing ambient background

	noises.
Residual Impacts:	This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.

7.7.4 Comparative Assessment of Grid Connection Options

There will be no differences in the significance of noise impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a noise perspective.

7.7.5. Cumulative impacts

The section specifically looks at the potential cumulative noise impact with all three phases operational (Karusa, Soetwater and Great Karoo Wind Farms). The wind turbine used for the modelling is the Vestas V90 3.0MW turbine (operating in mode 0) with the relevant octave sound power levels. A wind rose obtained from the developer indicates that the wind direction is predominantly north-west. Additional modelling will therefore be done for this wind speed using the Concawe model.

Cumulative projected Noise Levels in the area due to the operation of the entire Hidden Valley Wind Energy Facility are illustrated in the figures below (ISO model for a 5 m/s wind).

Figure 7.19 illustrates the projected cumulative noise levels due to the operation of the proposed Hidden Valley Wind Energy Facility with all three wind farms operating, with **Figure 7.20** illustrating how these operating wind farms may alter the environmental ambient sound levels.

Those figures only illustrate and evaluate the potential noise impact for a 5 m/s wind speed. A more appropriate method to determine the potential noise impact would be to make use of the projected noise levels due to the operation of the wind energy facility for all wind speeds as illustrated in **Figures 7.19 and 7.20.**

Using the model parameters as outlined in the noise report, the following can be concluded:

- As was seen with the Great Karoo Wind Farm, the is a possible risk that the larger Hidden Valley wind energy facility may have a noise impact of a low-medium magnitude, mainly due to the distance to wind turbines 143 (804 meters) and 140 (948 meters).
- The operation of this wind energy facility will have no noise impact on any other NSD.

- With the input data as used, this assessment indicated that the cumulative operation of all wind turbines will have an ***insignificant noise impact***.

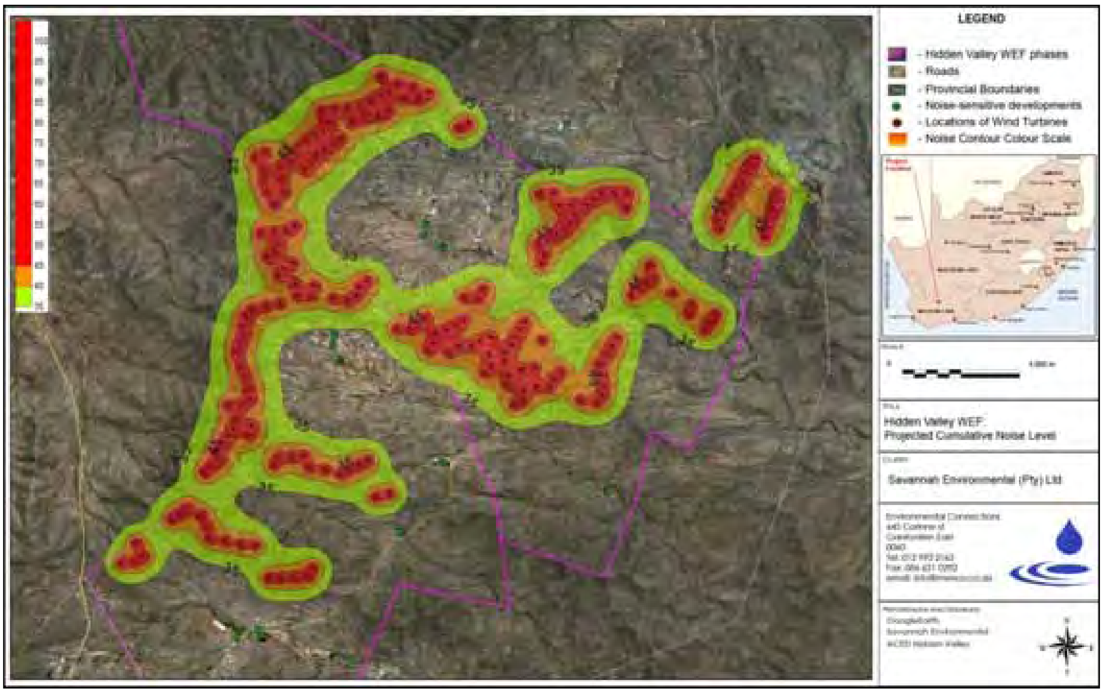

Figure 7.19: Projected Cumulative Noise Levels (ISO model) from Hiddden Valley wind energy facility; Contours of constant sound levels for a 5 m/s wind

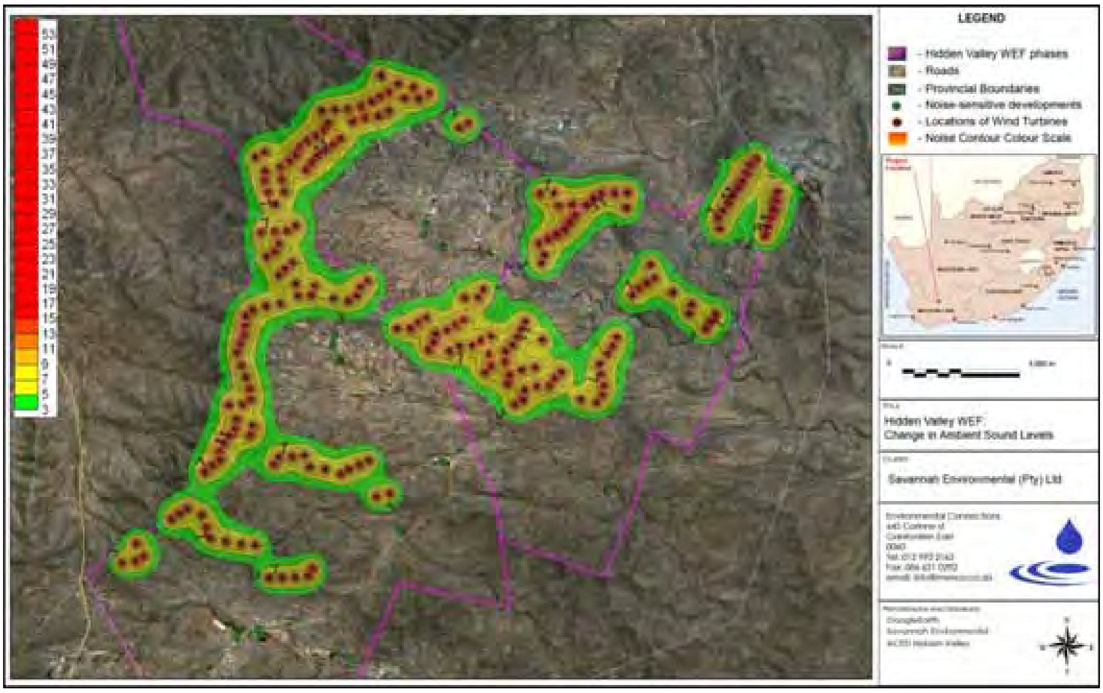

Figure 7.20: Projected change in ambient sound levels (ISO model); Contours of constant sound levels for a 5 m/s wind

Should the three other approved wind projects be developed, along with the Hidden Valley project, the cumulative impacts will have to be considered in a larger noise study, to be arranged by the relevant developers, as a joint effort, and based on final turbine layouts, as it is too difficult t predict at this stage.

7.7.6 Conclusions and Recommendations

By making use of predictive models to identify noise issues of concern, the noise assessment indicated that the proposed project will have a noise impact of low significance on all NSDs in the area during both the construction and operational phases using the Vestas V90 3.0MW wind turbine. However, mitigation measures are still proposed to reduce the potential noise impacts and risks to receptors.

With the input data as used, this assessment indicated that the proposed project will have a noise impact of a ***low significance*** on all current NSD in the area during both the construction and operational phases using the Vestas V90 3.0MW wind turbine for all wind speeds.

It should be noted that the noise impact was determined based on the outcome of a regression analysis that indicated that the likely long-term ambient sound levels could be significant during periods when wind speeds exceeds 4 m/s. The regression analysis is based on a number of measurements taken at various sites during periods when the wind was blowing, but when there were little other noise sources. As such it is recommended that the developer implement a monitoring programme before the development of the wind energy facility confirming the validity of the regression analysis of non-site specific data. It is therefore recommended that the ambient sound environment be defined over a longer period as per the environmental management programme.

In addition quarterly noise monitoring should be conducted by an acoustic consultant for the first year of operation. This monitoring is to take place over a period of 24 hours in 10 minute bins, with the resulting data co-ordinated with wind speeds as measured at a 10 meter height. These samples should be collected when the Wind Turbines are operational. Quarterly monitoring is recommended at NSD07 for the first year, as well as any other NSDs that have complained to the developer regarding noise originating from the facility.

Annual feedback regarding noise monitoring should be presented to all stakeholders and other Interested and Affected parties in the area. Noise monitoring must be continued as long as noise complaints are registered.

The findings of this report should also be made available to all potentially noise-sensitive developments in the area, or the contents explained to them to ensure that they understand all the potential risks that the development of a wind energy facility may have on them and their families.

With its potential for environmental and economic advantages, wind power generation has significant potential to become a large industry in South Africa. However, when wind farms are near to potential sensitive receptors, consideration must be given to ensuring a compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time the wind farms need to reach an optimal scale in terms of layout and number of units.

Wind turbines produce sound, primarily due to mechanical operations and aerodynamics effects at the blades. Modern wind turbine manufacturers have virtually eliminated the noise impact caused by mechanical sources and instituted measures to reduce the aerodynamic effects. But, as with many other activities, the wind turbines emit sound power levels at a level that can impact on areas at some distance away. When potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors.

It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source – but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels.

7.8 Assessment of Potential Impacts on Heritage - Archaeology

7.8.1 Impact of Construction on Pre-colonial Archaeology

The following heritage sites have been identified on the Karusa Wind Farm site and are shown in **Figure 7.21**:

» Graveyard on the Farm Standvastigheid 210 (mixed formal family graves and informal labourers' stone packed burials from th1 1800s – 1900's).
» Dry Packed Stone Walling Kraal of the Farm Standvastigheid 210
» Dry packed stone walling boundary fences/walls on the Farm Standvastigheid 210
» Farmstead Complex on the Farm De Hoop 202

None of the proposed wind turbines occur on these heritage sites, and it recommended that associated infrastructure (such as access roads) avoid these heritage sites. The NHRA stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

» Grade I: Heritage resources with qualities so exceptional that they are of special national significance;
» Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
» Grade III: Other heritage resources worthy of conservation on a local authority level.

The occurrence of sites with a Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the applicable mitigation measures would allow the development activities to continue. **All the heritage sites below have been classified as Grade III sites.**

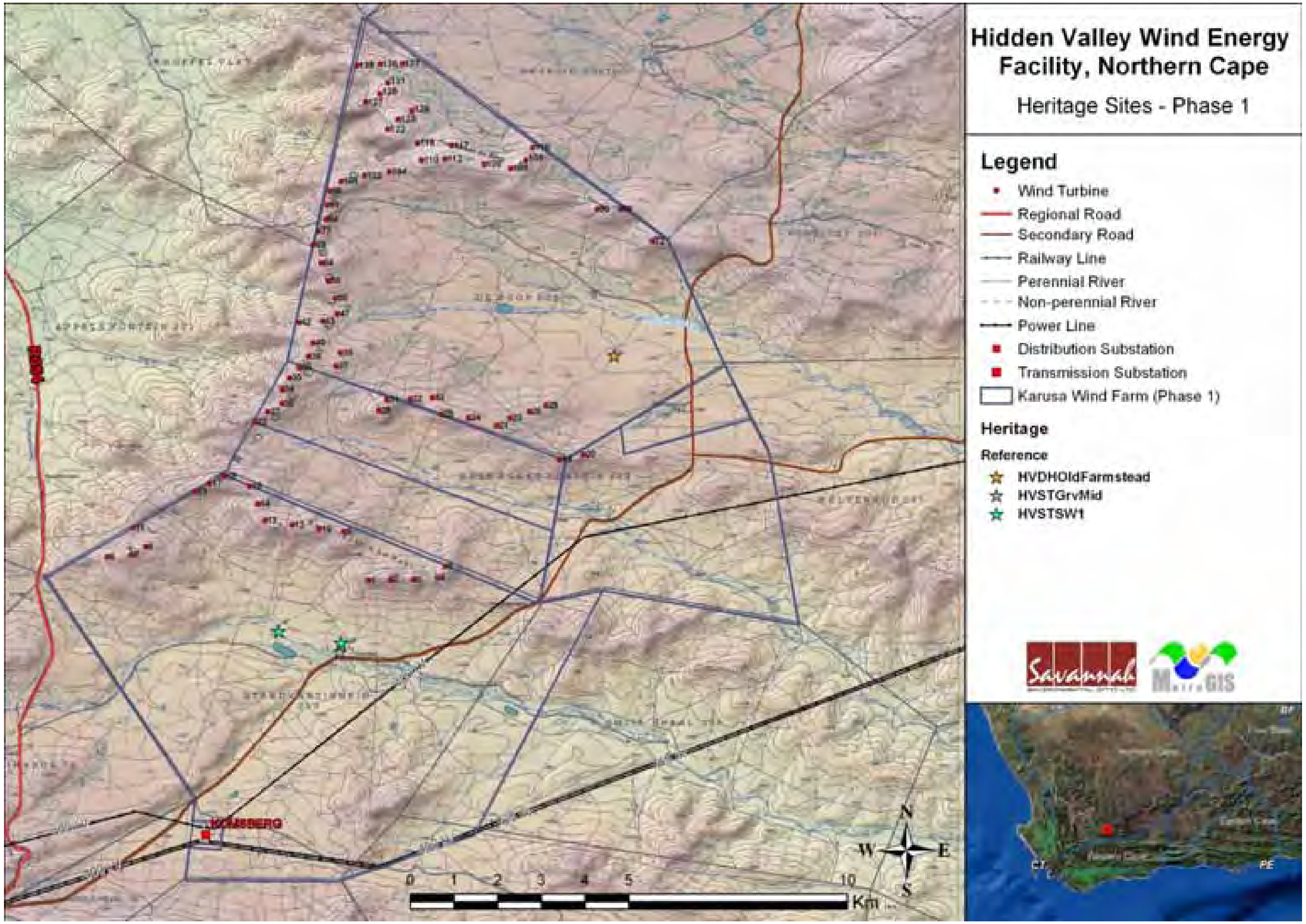

Figure 7.22: Grade III Heritage sites identified on the Karusa Wind Farm site

7.8.1.1 Impact Table – Impact of Construction on heritage artefacts

Nature: **The destruction of identified heritage sites during the construction of the turbines, substation, cabling between the turbines, access roads and workshop.**		
	Without mitigation	**With mitigation**
Extent	Local (5)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very High (10)	Moderate (6)
Probability	Highly Probable (4)	Improbable (2)
Significance	**High (80)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	None	Low
Irreplaceable loss of resources?	Yes	Low
Can impacts be mitigated?	Yes	Yes
Mitigation: » A 10m perimeter boundary fence must be established around the sensitive heritage structures (Dry Packed Stone Walling Dwelling on Portion 1 of the Farm Orange Fontein 203 (HVOFSW1) adjacent to the farm gravel road before and during all construction and development activities. » If concentrations of archaeological materials are exposed during construction then all work must stop for an archaeologist to investigate. If any human remains (or any other concentrations of archaeological heritage material) are exposed during construction, all work must cease and it must be reported immediately to the nearest museum/archaeologist or to the South African Heritage Resources Agency, so that a systematic and professional investigation can be undertaken. Sufficient time should be allowed to investigate and to remove/collect such material. Recommendations will follow from the investigation.		
Cumulative impacts: » Irreplaceable loss of historical heritage resources.		
Residual impacts: » Irreplaceable loss of historical heritage resources.		

7.8.3 Comparative Assessment of Grid Connection Options

There will be no differences in the significance of heritage impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a heritage impact perspective.

7.8.4. Cumulative impacts

There are heritage sites on all three development phases, therefore is these sites are destroyed during construction, there would a net increase in negative impacts on heritage artefacts. With mitigation, the impacts are of acceptable level. The same goes for the three other approved projects in the region.

7.8.5. Conclusions and Recommendations

No heritage sites occur within the development footprint of the proposed for infrastructure for the Karusa Wind Farm. However, historical archaeological remains, features and sites were documented and have been reported in the Phase 1 archaeological impact assessment (AIA). These sites occur in the broader farm portion. These remains, features and sites have been highlighted as they occur adjacent to the possible main access roads that will be used during the construction and development activities.

The site therefore has a medium-high cultural sensitivity according to the sensitive heritage remains, features, and site encountered, the following recommendations are made:

- A professional archaeologist (with an already authorised collection permit – if necessary) must be appointed during construction to monitor and identify possible archaeological material remains and features that may occur below the surface and make further appropriate recommendations on removing and / or protecting the archaeological material remains and features.
- If concentrations of archaeological heritage material and human remains are uncovered during construction, all work must cease immediately and be reported to the Albany Museum (046 622 2312) and/or the South African Heritage Resources Agency (SAHRA) (021 642 4502) so that systematic and professional investigation/ excavation can be undertaken.
- Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites.
- ***Site Specific Recommendations:***
  - *Graveyard (HVSTGrvMid) on the Farm Standvastigheid 210 (Phase 1):*
    An alternative access route must be considered for the construction and development activities for the wind energy facility.
  - *Dry Packed Stone Walling Kraal on the Farm Standvastigheid 210 (Phase 1):*
    An alternative access route must be proposed for the construction and development activities for the wind energy facility.

- *Dry Packed Stone Walling Boundary Fences/Walls on the Farm Standvastigheid 201 (HVSTSW and HVSTSW1) (Phase 1):*
  An alternative access route must be considered for the construction and development activities for the wind energy facility.
- *Farmstead Complex on the Farm De Hoop 202 (HVDHOldFarmstead) (Phase 1):*
  An alternative access route must be considered for the construction and development activities for the wind energy facility. If there is no alternative route available for accessibility during the construction and development of the wind energy facility, and access can only occur on the road through the farmstead complex, the section through the farmstead complex may not be widened to the extent that the activities would be destructive on the sensitive heritage structures.

» A 10m perimeter boundary fence must be established around the identified sensitive heritage structures adjacent to the farm gravel road before and during all construction and development activities.

7.9 Assessment of Potential Impacts on Palaeontology

7.9.1. Findings or Loss of Fossils during Construction

The construction phase of the wind energy facility will entail excavations into the superficial sediment cover (soils, etc.) and perhaps also into the underlying bedrock. These include excavations for the turbine foundations, buried cables, new internal access roads and foundations for associated infrastructure such as an on-site substation and workshop / administration building. In addition, sizeable areas of potentially fossiliferous bedrock may be sealed-in or sterilised by infrastructure such as hard standing areas for each wind turbine, lay down areas and internal access roads. All these developments may adversely affect potential fossil heritage within the study area by damaging, destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good. Once constructed, the operational and decommissioning phases of the wind energy facility will not involve further adverse impacts on palaeontological heritage.

The site is associated with continuous Permian-age sedimentary strata that cover large geographical areas, as well as more recent Quaternary- age alluvial and superficial valley fill deposits that occur as localized events. The area within which the wind energy facilities are to be constructed is primarily underlain by *in situ* strata of the fossil-bearing Abrahamskraal Formation (*Pa*). Quaternary alluvial deposits, especially near water courses and drainage lines, have the potential to yield microfossil and fossil mammal remains as well as Early Stone Age archaeological remains. The proposed development located within igneous bedrock (dolerite) represents no paleontological impact.

In general, the destruction, damage or disturbance out of context of fossils preserved at the ground surface or below ground that may occur during construction represents a negative impact that is limited to the development footprint. Such impacts can usually be mitigated but cannot be fully rectified (i.e. permanent). Because of the generally sparse occurrence of fossils within most of the formations concerned as well as within the overlying superficial sediments (soil, etc.), as inferred from better exposed localities elsewhere, the magnitude and probability of impacts are conservatively rated as low.

The overall impact significance of the construction phase of the proposed wind farm project is assessed as low (negative) without mitigation. It should be noted that, should fossils be discovered before or during construction and reported by the responsible ECO to the responsible heritage management authority (SAHRA) for professional recording and collection, as recommended here, the overall impact significance of the project would be further reduced. Residual negative impacts from any loss of fossil heritage would be partially offset by an improved palaeontological database as a direct result of appropriate mitigation. This is a positive outcome because any new, well-recorded and suitably curated fossil material from this palaeontologically under-recorded region would constitute a useful addition to our scientific understanding of the fossil heritage here.

The intent of mitigation and lessening of impact is to identify fossil localities for future avoidance or to recover in situ fossils before possible damage or destruction. However, effective mitigation of potential paleontological impact for this project is only feasible once the final positions of all individual structures and access roads have been finalised.

7.9.1.1 Impact Table – Impact on fossil heritage resources during the construction phase

Nature: Construction of the turbines, underground electrical grid, substation, associated building structures and access roads will impact on fossil-bearing sediments composed of Abrahamskraal Formation strata (Adelaide Subgroup). These sediments are regarded as of high overall paleontological significance, especially with regard to potential impact on vertebrate, invertebrate, plant and trace fossils. Late Quaternary alluvial and valley fill deposits in the area, especially near water courses and drainage lines, are of moderate overall paleontological significance and have the potential to yield fossil mammal remains as well as Early Stone Age artefacts. Potential paleontological heritage identified in the affected area could be negatively affected during the construction phase of the development.

	Without mitigation	**With mitigation**
Extent	Local High (5)	Local Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Moderate (6)
Probability	Probable (3)	improbable (2)
Significance	**Medium (50)**	**(Low) 24**
Status (positive or negative)	Negative	Positive
Reversibility	Improbable	Possibility
Irreplaceable loss of resources?	High	High
Can impacts be mitigated?	Yes	
Mitigation: » Monitoring of areas where the concrete foundations for each turbine will be placed, where underground cables connecting the turbines with the substation will be placed, where the substation and office facilities will be constructed and where access roads will be located to provide access to each turbine site, **before** the commencement of development. » 2) Monitoring of fresh exposures and bedrock excavations into the fossil-bearing strata **during** the construction phase of development.		

7.9.2 Comparative Assessment of Grid Connection Alternatives

There will be no differences in the significance of fossil heritage impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a fossil impact perspective.

7.9.4. Cumulative impacts

The cumulative impact on fossils from the Karusa Wind Farm, and the other two phases, will not have a significant impact on palaeontology.

7.9.5. Conclusions and Recommendations

The proposed development located within igneous bedrock (dolerite) represents no major paleontological impact.

CONCLUSIONS AND RECOMMENDATIONS FOR PHASE 1 – KARUSA WIND FARM CHAPTER 8

ACED Renewables Hidden Valley (Pty) Ltd is proposing to establish a commercial wind energy facility and associated infrastructure on a site located within the Karoo Hoogland Local Municipality. The site is located within the Karoo Hoogland Local Municipality (approximately 30 km south of Sutherland in the Northern Cape Province). ***This Chapter of the EIA report deals only with the conclusions and recommendations of the EIA for the Phase 1 of the larger "Hidden Valley Wind Energy Facility" referred to as the Karusa Wind Farm (DEA Reference Number 12/12/20/2370/1).***

The Karusa Wind Farm is proposed on the following farm portions (which collectively occupies land of 136.2 km^2 in extent):

» Farm De Hoop 202
» Farm Standvastigheid 210
» Portion 1, 2, 3 and the remainder of Farm Rheebokke Fontein 209

The primary components of the Karusa Wind Farm include the following:

The project will include the following infrastructure:

» Up to **57 wind turbines**[18], appropriately spaced to make use of the wind resource on the site. The generating capacity of the facility will depend on the final turbine selected for implementation by ACED but will be limited to 140MW at the point of connection with the Eskom grid. The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.
» Each wind turbine is expected to consist of a concrete foundation (20m x 20m), a steel or concrete tower, a hub (between 80m and 120m above ground level, depending on the turbine size decided upon) and three blades with a rotor diameter of up to 120m.
» Cabling between the components, laid approximately 1 m underground where underground cabling is feasible. In as far as possible, cabling will follow the internal access roads[19].

[18] Initially 74 wind turbines were proposed but this has been reduced to 57 in response to assessments and specialist recommendations.

[19] Where underground cabling is not practical or environmentally sensible (e.g. in rocky area where blasting would be required), cabling would be above ground, suspended between ~8m high timber poles at ~60m centres.

» Internal roads (approximately 8 m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines and the vast areas of the site which are not currently accessible will necessitate the construction of ~35 km of new access roads in some areas.
» A new on-site **substation complex** (with a capacity of up to 400kV) to connect to the Komsberg Substation located in the south west corner of the site development footprint. The substation will have a high-voltage (HV) yard footprint of approximately 40 000 m^2.
» Overhead 132 kV double circuit power line to connect the substation to the Eskom grid at the Komsberg Substation, requiring a servitude of approximately 36 m in width.
» **Operations and service building area** for control, maintenance and storage (approximately 2000m^2).
» **Guard house** for access security of 50$m^{2.}$

The environmental impact assessment (EIA) for the proposed Karusa Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice 33306, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998) and the EIA Regulations of June 2010 (as amended).

The EIA Phase aimed to achieve the following:

» Provide an overall assessment of the social and biophysical environments affected by the proposed development forward as part of the project.
» Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed wind energy facility.
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

The purpose of this amended Final EIA Report for the Hidden Valley Wind Energy Facility is to include the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes as well as updating the project information where necessary.

8.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices F - S provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the proposed project. This chapter concludes the EIA Report by providing a summary of the conclusions of the assessment of the proposed site for the wind energy facility and the associated infrastructure such as the substation and overhead power line. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental team during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project.

The assessment of potential environmental impacts presented in this report is based on a preliminary layout of the turbines and associated infrastructure provided by ACED (Pty) Ltd. This layout includes 74 wind turbines as well as associated infrastructure. As mentioned, subsequent to the bird and bat monitoring surveys the turbine count has been reduced to 57 in response to assessments and specialist recommendations (this is discussed in detail in the Mitigation Section8.5.1). No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of medium to high significance were identified which require mitigation (thereafter the impacts can be reduced to medium – low significance). Mitigation to avoid impacts is primarily associated with the relocation (or in some instances, the elimination) of certain turbine positions of concern, as well as measures during the construction phase to prevent negative impacts from occurring. Removal and relocation mitigation has been implemented. Mitigations are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Programme (EMPr) included within Appendix N.

The sections which follow provide a summary of the most significant environmental impacts associated with the proposed project, as identified through the EIA, as well as a mitigation strategy in order to reduce the impacts

8.2. Summary of All Impacts

As a summary of the potential impacts identified and assessed through the EIA process in terms of the preliminary layout of 74 turbines and associated infrastructure, Table 8.1 indicates the significance ratings for the potential biophysical, ecological, visual and social impacts. It is worth noting that the while the assessment was based on 74 turbine positions this has subsequently been reduced to 57 in response to assessments and specialist recommendations. Letters from the specialist have been provided and this is discussed in more detail later sections.

As indicated in Chapter 3, the significance weightings for potential impact have been rated as follows:

» **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
» **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)
» **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

Table 8.1: Summary of potential impacts identified and assessed through the EIA process

Nature	Without mitigation	With mitigation
Impacts on Ecology		
Loss or fragmentation of indigenous natural vegetation	Medium	Medium
Impact on threatened plants	Medium	Medium
Impact on Wetlands	High	Low
Impact on threatened animals species / habitat	Low	Low
Alien vegetation growth due to disturbance	Medium	Low
Impacts on Avifauna		
Bird mortalities due to collisions with wind turbines	Medium	Medium
Impact on birds due to disturbance	Medium	Medium
Loss of avifauna habitat	Medium	Low
Electrocution/ collision of birds with the power line	Medium	Low
Impacts on Bats		
Bat mortalities due to direct blade impact or barotrauma during foraging	High	Low
Bat mortalities due to direct blade impact or barotrauma during migration	Medium	Low
Destruction of bat roosts during construction	Low	Low

Impacts on Soil, Land Use, Land Capability and Agricultural Potential		
Loss of land with high agricultural potential and land capability	Low	Low
Soil Erosion / degradation during Construction	Medium	Low
Soil contamination / soil erosion during the operation of the facility	Low	Low
Social Impacts		
Creation of Employment and Business Opportunities during the Construction Phase	Medium	Medium
Impact of the presence of construction workers in the area on local communities	Low	Low
Risk of Stock theft and damage to farm infrastructure	Medium	Low
Increased risk of fires during construction	Medium	Low
Increases traffic on roads due to construction	Low	Low
Operational Phase -Creation of Long- Term employment and business opportunities	Low	Medium
Contribution of the project towards Development of Renewable Energy Infrastructure in South Africa	Medium	Medium
Long-Term Impact of the project on Existing Farming Activities on the Site	Low	Low
Impact of the wind energy facility on tourism in the region	Medium	Medium
Health Impacts due to the Operation of the wind energy facility	Low	Low
Visual Impacts		
Change in visual character and sense of place	Medium	N/A
Visual impact of lighting at night on visual receptors in close proximity to the proposed facility	Medium	Medium
Shadow Flicker	Low	Low
Noise Impacts		
Noise impacts due to construction activities	Low	Low
Noise impacts from the wind turbines – operational phase	Low	Low
Impacts on Heritage Artefacts		
Impact of construction on pre-colonial	Medium	Low

archaeology		
Potential Impacts on Palaeontology		
Findings or Loss of Fossils during Construction	Medium	Low

8.2.1. Quantification of Areas of Disturbance on the Site

Site-specific impacts associated with the construction and operation of the proposed wind energy facility relate to the direct loss of vegetation and species of special concern, disturbance of animals and loss of habitat and impacts on soils. A wind energy facility is, however, dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. A site of 136.2 km^2 was considered for the facility, of which less than 1% will be utilised for the wind energy facility. The bulk of this effective area required for the facility footprint would not suffer any level of disturbance as a result of the required activities on site. This is explained further below.

Permanently affected areas comprise 74 turbine footprints (74 foundation areas of 20m x 20m), access roads (up to 8 m in width), one 400 kV substation footprint (200m x 200 m) and an operations and service building area (200m^2). The area of permanent disturbance is approximated as follows:

Facility component - permanent	**Approximate area/extent (in m^2)**
57 turbine footprints (each circa 20m x 20m)	22 800
Permanent access roads within the site (8 m in width)	150 000
One on-substation complex footprint (circa 200m x 200 m)	40 000
Operations and service building area (circa 50m x 240m)	12 000
TOTAL	224800 m^2 (of a total area of 136 200 000m^2) **i.e. 0.16% of site**

Temporarily affected areas comprise 57 foundation areas, laydown areas for turbines (each laydown area assumed to have a footprint of 60 m x 60 m) and possibly a track of 11 m in width if a crawler crane is required to move across the site (i.e. an additional 6 m width to the permanent road of 8 m in width). The area of temporary disturbance is as follows:

Facility component - temporary	Approximate area/extent (in m^2)
57 turbine laydown areas and crane hardstands (60 m x 60m)	205200
TOTAL	495 000(of a total area of136 200 000m^2) = **0.15 % of site**

Therefore, less than 0.5% of the entire site can be anticipated to be disturbed to some extent during the construction and operation of the Karusa Wind Farm.

8.3 Comparative Assessment of Grid Connection Alternatives

A new on-site Karusa **Substation** (with a capacity of up to 400kV) is required to connect directly to the Komsberg Substation located in the south west corner of the site development footprint. Two options for the location of the substation are proposed. Both substation options are located on Farm Standvastigheid, directly adjacent to the existing Eskom Droerivier-Komsberg 2 400 kV power line. The on-site substation will connect to the Komsberg Substation through an overhead high voltage double circuit power line.

Substation Option 1 is technically preferred. A comparative assessment of the two substation locations and grid connection alternatives is summarised in **Table 8.2**. Substation Option 1 is nominated as the preferred alternative from an environmental perspective.

Table 8.2: Comparison of recommendations for Substation Alternatives

	Karusa Substation Option 1 (Technically preferred)	**Karusa Substation Option 2 (Alternative)**
Ecology (Flora)	» Substation Option 1 is preferred from an ecological perspective as it is located outside of all areas with ecological sensitivity.	» Substation Option 2 is located near a ridgeline that is considered of high sensitivity according to the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 area (steep slopes) and is therefore less favourable from an ecological perspective compared to Option 1.
Avifauna	» Substation Option 1 is located outside of the high and medium avifauna areas and is therefore acceptable from an avian perspective.	» Substation Option 2 is located outside of the high and medium avifauna areas and is also acceptable from an avian perspective although slightly less preferable.
<u>Bats</u>	» <u>No preference</u>	» <u>No preference</u>
Soils	» The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation alternatives in terms of impacts of soils or geology. » The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation alternatives in terms of impacts of soils or geology.	
Social	» No preference applicable in terms of social impacts, therefore both substation options are acceptable.	
Visual	» There will be no differences in the significance of visual impacts for any of the alternative substations. This is because the region in which the site is located is sparsely populated, with large distances between one homestead and the next. Furthermore, the visual landscape is already disturbed with the current 400 kV substation on the site as well as power lines, which the substation will be located next to. Therefore either of the proposed alternatives are considered acceptable from a visual impact perspective. .	
Noise	» Both substations are further than 200m from noise receptors, therefore both options are acceptable in terms of transformer noise.	
Heritage	» Both substation options occur outside of the heritage sites and are therefore both acceptable from a heritage point of view.	
Palaeontology	» No preference between the options, and both substation options are acceptable.	

8.4 Cumulative Impacts

Based on the information available at the time of undertaking the EIA, four authorised wind energy facilities are proposed in the immediate study area. These are listed in Table 8.2. None of the planned projects in the vicinity of the Hidden Valley site on both the Northern Cape and Western Cape side of the provincial boundary have preferred bidders status at the time of writing this EIA report.

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 be developed. It is considered that not all proposed developments will be granted the relevant permits by the relevant authorities (DEA, DoE, NERSA and Eskom) and this is because of the following reasons:

- There are limitations to the capacity of the existing Eskom grid.
- Not all applications will receive positive environmental authorisation.
- There are stringent requirements to be met by applicants.
- Not all proposed wind farms will be viable because of the wind resource.
- Not all wind farms will be able to reduce negative impacts to acceptable levels or able to mitigate adequately.
- Not all proposed wind farms may be granted a generation license by NERSA and sign a Power Purchase Agreement with Eskom.

Table 8.2: Proposed wind farm developments in the vicinity of the Hidden Valley Site

Wind Farm (Developer)	No. of turbines	Distance (km)	Status of the development	DEA Reference Number
1. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Roggeveld	Authorisation received	12/12/20/1783
2. Witberg Wind Farm (G7 Renewable Energies)	Up to 27	Approx. 25km south of Roggeveld	Authorisation received	12/12/20/1966
3. Sutherland	293 to 386	Approx 35km	Authorisation	12/12/20/1782

	(wind and solar) (Mainstream SA)		north east o/f Roggeveld	received	
4.	Suurplaat Wind Farm (Moyeng Energy)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received	12/12/20/1583
5.	Roggeveld Wind Farm (G7 Renewable Energies)	Approximately 207	Adjacent to the Hidden Valley site (to the west)	EIA in process	12/12/20/1988/1-3
6.	Gunstfontein (wind and solar) Networx Eloes	Approximately 100	Adjacent to the Hidden Valley site (to the north)	EIA in process	14/12 /16/3/3/2/399 (wind) 14/12/16/3/3/2/395 (solar)

The combined effect of the various wind farms proposed for this area will have a cumulative visual impact and impact on the landscape character. The significance of this cumulative impact is uncertain as at the time the assessment was undertaken the details of the final layouts of adjacent or neighbouring facilities were not available and could therefore not be quantitatively assessed. Cumulative impacts discussed below and have been considered within the detailed specialist studies, where applicable (refer to Appendices F - S):

The potential ***direct cumulative impacts*** as a result of the proposed project are expected to be associated predominantly with:

» *Visual impact* - This impact may be sequential and additive, due to the visibility of wind turbines from three or more within 10-20 km of each other. From a visual perspective, the overlapping viewsheds can be considered favourable, as it represents the consolidation and concentration of potential visual impacts within a clustered region (i.e. the development of a wind energy facility node, rather than dispersing the impact to other areas). In addition, this region of the Karoo is sparsely populated, with large distances between one farmstead and the next and between one town and the next.
» *Social* (linked to visual) - The establishment of four or more wind energy facilities in the area may impact negatively on the landscape and the areas rural sense of place and character. The cumulative impact will however to some extent be moderate due to the relatively low incidence of visual receptors in the region. On the other hand, cumulative positive socio-economic impacts from three or more wind energy facilities in terms of job creation and economic

growth and development of infrastructure will occur in a local and district municipality that is in need of this growth and development may be significant.

» *Impact on SALT – The intensity of light generated by the wind energy facility is* expected to be of a lower order than that generated by the urban area of Sutherland due to the dispersed nature of the turbines. The distance of the SALT from the wind energy facility and the elevated position of the SALT reduce the significance of this impact to insignificant. The furthest extent of direct visibility of turbine hubs and lights in the direction (NE) of the SALT is 10km. The project may impact on (due to lighting) the day-to-day operations of the observatory. However, approval of the Hidden Valley wind project will be contingent on ACED's ability to prove that the facility will not contravene the provisions of the Astronomy Geographic Advantage (AGA) Act (2007).

The potential ***indirect cumulative impacts*** as a result of the proposed project are expected to be associated predominantly with:

» *Flora, fauna, and ecological processes* - (impacts that cause loss of habitat may exacerbate the impact of the proposed facility impact) at a regional level driven mostly by the possibility of other similar facilities being under construction simultaneously. Impacts related to disturbance, habitat loss and collision related mortality of avifauna may become cumulative if other wind energy facilities are developed in the region. Should the Hidden Valley project and the four other above-mentioned proposed wind projects in the region be developed, cumulative negative ecological impacts may occur. The significance of this impact is expected to be of a moderate significance and can result in a cumulative loss of biodiversity (particularly for protected plants and animal species and soil erosion). However, if negative impacts on ecology is effectively mitigated and managed for each project, through sound environmental management during construction and operation and by formal conservation and active management of the natural areas on site, then the negative impacts on ecosystems on each site can be within acceptable levels, and therefore in keeping with the principles of sustainable development. With the implementation of good environmental management practise during the life cycle of each project, cumulative impacts on ecology as a result of the establishment of various wind energy facilities in the area could be of an acceptable level.
» *Avifauna* - The cumulative effect of the four or more wind energy facilities on bird species of conservation concern may be moderate, without mitigation. It is, therefore, imperative that pre-construction and post-construction monitoring is implemented on each site using any accepted or endorsed bird monitoring guidelines or standards to provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species.

Turbines should be carefully placed outside of sensitive areas as is the case on the Karusa Wind Farm. This will provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. Furthermore, when viewed in isolation, one wind energy facility may pose only a limited threat to the avifauna of the region. However, in combination they 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 repeated arrays of turbines spread across foraging areas and/or flight paths of priority species.

» *Bats*: Cumulative impacts on bats due to multiple wind energy facilities in the region will be of a medium significance if project specific mitigations are implemented for each project such as careful location of turbines outside of sensitive areas as is the case on the Karusa Wind Farm.
» *Cumulative geology, soil and erosion potential* - although the impact of soil removal for the proposed activity has a moderate – low significance, the cumulative impact of soil removal in the area is considered low due to undeveloped nature of the area. The cumulative impact of soil pollution in the area is considered moderate. The cumulative impact of siltation and dust in the area is considered low, with the legal obligation of good soil management for each project.
» *Cumulative noise impacts* - the impact of numerous simultaneous construction and operation activities that could affect potential sensitive receptors is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area. The potential for cumulative impacts is low.
» *Infrastructure* - Increased pressure on existing roads and other infrastructure may occur.
» *Heritage* –Cumulative changes to the pre-colonial cultural landscape in terms of visual impacts and changes to ‘sense of place’ will occur from various projects in the region. The potential for the loss or find of heritage artefacts in the Karoo region will also increase.

8.5 Environmental Sensitivity Mapping and Recommendations

From the specialist investigations undertaken for the proposed Karusa Wind Farm development site, a number of potentially sensitive areas were identified (refer to **Figure 8.1**) where walk-through surveys are required to be undertaken to confirm the final placement of turbines and other associated infrastructure within these areas (including substation complex, access roads and power line routes).

No absolute environmental 'no go' areas were identified on the site. However, the following sensitive areas have been identified on the site:

» Habitats and vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 having elevated conservation value and, for that reason, has been classified here as having ecological and avifaunal sensitivity (for this site - important terrestrial habitats are **south-facing slopes** larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (rated as being of medium sensitivity).

» Areas classified as mountains, ridges or **steep slopes**: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).

» Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in **natural habitats** within the study area.

» Perennial and non-perennial rivers, streams and watercourses. These support the ecosystems in the areas and may provide habitat for priority avifauna and foraging areas for bat species.

» Noise sensitive receptors (farmsteads on / around the site, albeit limited).

» Heritage artefacts (graves, stone walls and old buildings/ruins present on the site). (Note that no infrastructure is proposed on the identified heritage sites, but these features remain of heritage value and are sensitive to disturbance).

» Areas of high avifaunal sensitivity include rivers, streams, farm dams and slopes. Based on the results of the pre-construction bird monitoring twelve (12) wind turbines turbines (79, 81, 86, 90, 107, 110, 167, 173, 174, 178, 182 and 34 (lies in river buffer zone) fell within the high risk areas for avifauna. It was recommended that these turbines should be relocated to areas outside of the high risk areas as informed by the pre-construction bird monitoring study.

» Areas of high bat sensitivity also include, rivers, farm dams and slopes. No turbines occur in the areas of high bat sensitivity, however Turbine 118 did occur in the bats high sensitivity buffer (river, dam and slopes with buffer zones) and it was recommended that it should be relocated.

Should mitigation measures be adhered to, impacts on the identified sensitive areas can be adequately managed.

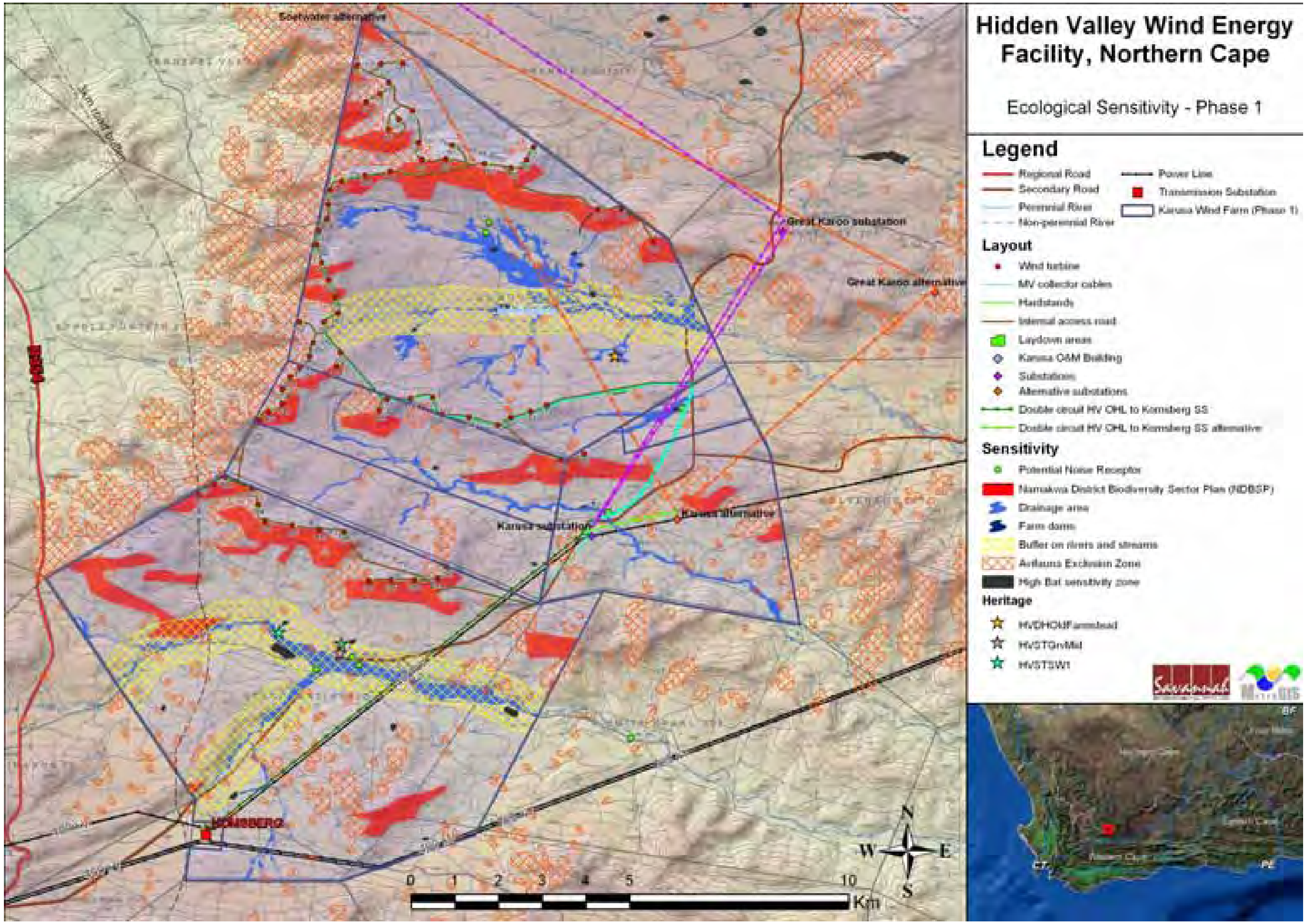

Figure 8.1: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the proposed Karusa Wind Farm development footprint

8.5.1. Mitigation Strategy

In response to the identified need to adequately manage impacts within sensitive areas identified on the site development footprint, and in order to demonstrate the ability of the project to adhere to recommended mitigation measures, the project developer has developed a best practice mitigation strategy with regards to the facility layout.

The EIA recommendations have been taken into account by the project developer, and the wind turbine layout has been refined to avoid the areas identified as being of high sensitivity. This refinement of the layout has resulted in the removal of turbines from the layout completely and the repositioning of turbines outside of identified sensitive areas. This refined layout shows a change in the number of wind turbines for the Karusa Wind Farm site from 74 to 57 (i.e. less turbines are proposed for construction within the Karusa Wind Farm). This refined layout considering the required mitigation measures is illustrated in Figure 8.2 and represents a positive outcome in terms of impact reduction and mitigation and the optimal layout for the facility.

The table below summarises which wind turbines have been moved out of sensitive areas, and which turbines have been removed from the layout.

Turbine Number - EIA-assessed layout for Phase 1 (Karusa Wind Farm)	**Reason for repositioning of turbine**
34, 79, 81, 86, 90, 107, 110, 167, 173, 174, 178, 182	Avifaunal risk – 12 turbines located within an identified high risk area Action: 12 turbines **removed** from the layout
118	Bat risk – one turbine located within an identified area of high bat activity Action: 1 turbine **removed** from the layout
73, 204, 205, 207	Bat risk – 4 turbines located immediately outside of moderate bat sensitivity buffer Action: Although no action was required, the project developer has adhered to best practice and the precautionary principle and therefore 4 turbines **repositioned** within the layout.
197, 200, 201, 202	Visual impact and issue raised by SAHRA relating to sense of place – 4 turbines located within 3km of the R354 Action: 4 turbines **removed** from the layout.

Reflected in the revised map (Figure 8.2), a new logical numbering system has been applied to account for the reduction in turbine numbers and a distinction between the three phases of the broader project. As is evident from the revised layout and sensitivity map (refer to Figure 8.2) the layout adheres to the mitigation strategy having no wind turbines located in environmentally highly sensitive areas. Other additional minor movements to turbines to uphold energy generation efficiency were also required in order to accommodate the revision of turbine positions around environmental exclusion zones. This revised layout responding to the mitigation measures was shared with the specialist team, and letters and assessment reports have been obtained (and appended to this amended FEIR) in support of the layout revision. It is confirmed by the specialists that the layout which responds to the mitigation strategy is environmentally acceptable, and either reduces the impacts as originally assessed, or the impact significance ratings remain unchanged.

Letters from specialists confirming the acceptability of the revised layout are attached as Appendix T. The optimised layout is considered to address sensitivity issues raised through the EIA process, and is supported by the EAP and EIA specialist team for Environmental Authorisation.

Planning of the positioning of infrastructure in this new layout has taken factors into account with respect to existing disturbance on site. Existing road infrastructure will be used as far as possible for providing access to proposed turbine positions. Where no road infrastructure exists, new roads should be placed within existing disturbed areas as far as possible or environmental conditions must be taken into account to ensure the minimum amount of damage is caused to natural habitats and that the risk of erosion or downslope impacts are not increased. Road infrastructure and cable alignments should coincide as much as possible.

The developer must consider the mitigation measures proposed in the heritage impact assessment (Appendix J). Grave and burial areas must be identified and cordoned off before construction and an archaeologist should be appointed to inspect the exact and immediate surrounding area for possible sites once the final positions for the wind turbines and other infrastructure are known. An ECO should also be appointed during the construction phases to observe whether any depth of deposit and in situ archaeological material remains is uncovered. If at any stage during the construction phase any semblance of a fossil is observed, it would be necessary to stop the work immediately and report this occurrence to SAHRA and/or a professional palaeontologist.

The developer should consider the various mitigation options as suggested in the noise EIA assessment (Appendix K) to reduce the significance of the potential noise impact on any sensitive receptors to an impact of lower significance.

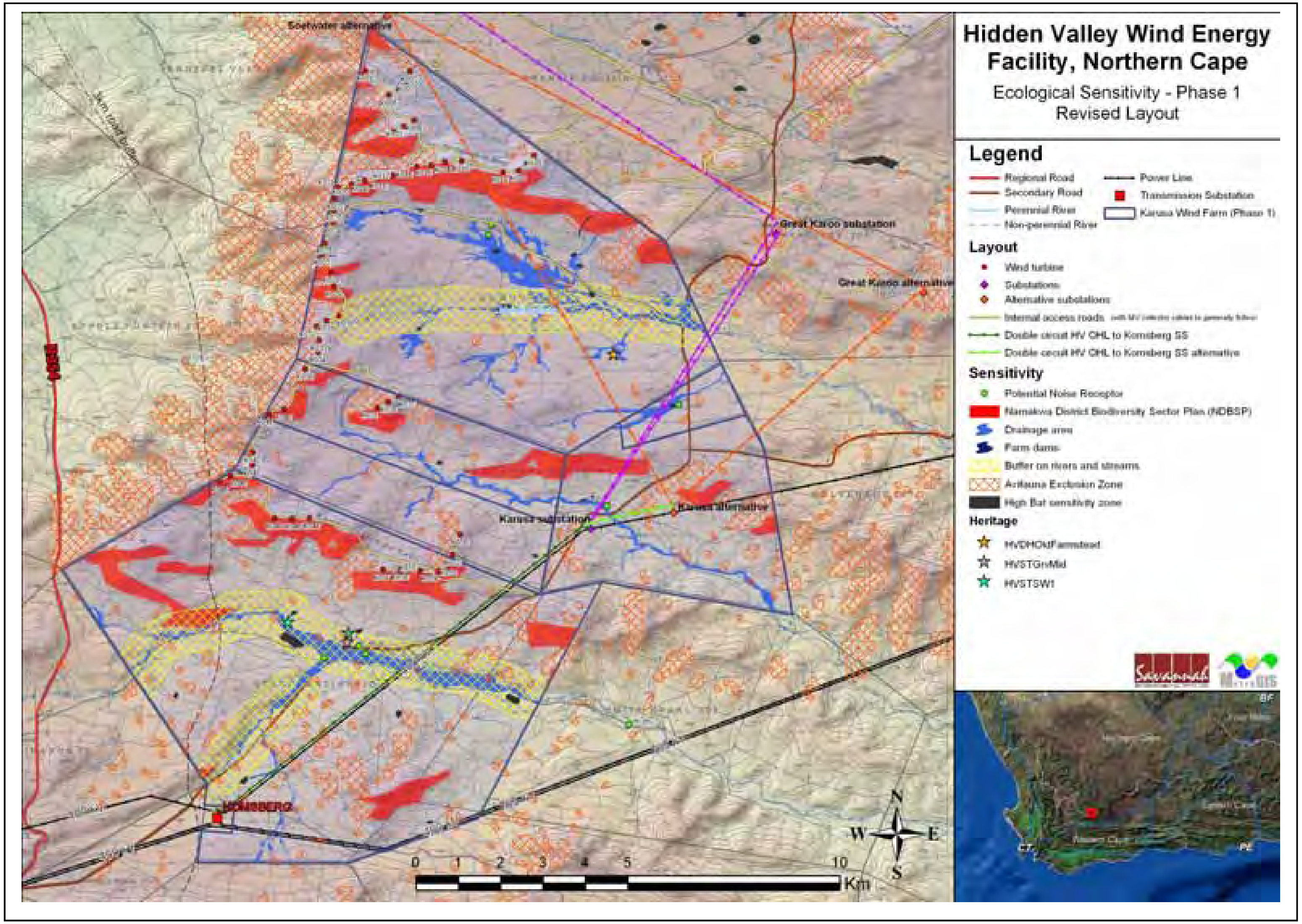

Figure 8.2: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the revised Karusa Wind Farm layout for DEA approval

8.6. Overall Conclusion (Impact Statement)

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of resources. In order to meet the long-term goal of a sustainable renewable energy industry in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation capacity being derived from renewable energy forms by 2030.

Through pre-feasibility assessments and research, the viability of establishing the Karusa Wind Farm, in the Northern Cape has been established by ACED. The positive implications of establishing a wind energy facility on the demarcated site include:

» The project would assist the South African government in reaching their set targets for renewable energy.
» The potential to harness and utilise good coastal wind energy resources on this site would be realised.
» The National electricity grid in the Eastern Cape would benefit from the additional generated power.
» Promotion of clean, renewable energy in South Africa.
» Creation of local employment and business opportunities for the area.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

» There are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
» The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With

reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

8.7. Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the facility and associated substation and power line, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Karusa Wind Farm and associated infrastructure can and has been mitigated to an acceptable level, provided appropriate mitigation is implemented and adequate regard for the recommendations of this report and the associated specialist studies is taken during the final design of the project.

<u>The revised layout shown in Figure 8.2 is acceptable</u> and the following conditions would be required to be included within an authorisation issued for the project:

» All mitigation measures detailed within this report and the specialist reports contained within Appendices F to <u>S</u> must be implemented.
» The draft Environmental Management Programme (EMPr) as contained within Appendix N of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed wind energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
» Following the final design of the facility, a revised layout must be submitted to DEA for review and approval prior to commencing with construction.
» Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
» A comprehensive search for threatened and near-threatened plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure if known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate

infrastructure, a permit may be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.

» The final location of the wind turbines and associated infrastructure within identified sensitive areas (if any) must be informed by surveys undertaken by ecological and avifaunal specialists. The findings of these surveys must be included in the site-specific EMPr to be compiled for the project.
» Implement an operational phase monitoring programme to record the impact on bat species using the site.
» Implement an operational phase monitoring programme to record the impact on bird species using the site.
» Establish an on-going monitoring programme to detect, quantify and remove any alien plant species that may become established.
» Adequate stormwater management measures to be put in place as the soils on the site may be prone to erosion due to shallow profiles and steep slopes.
» Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads).
» Plan the road and site layout in such a way as to make maximal use of existing roads and fence/border areas to minimise impacts and to keep grazing and natural units as intact as possible.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» Use of fire prevention and fire management strategies for the wind energy facility, to reduce risks to landowners.
» Implement a noise monitoring programme before the development of the wind energy facility. If needs be, quarterly noise monitoring should be conducted by an acoustic consultant for as long as noise complaints are registered.
» Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites (as detailed in the EMPr).
» The heritage artefacts identified in the EIA must be cordoned / protected prior to the start of construction, to ensure that heritage sites are not destroyed. Applications for all other relevant and required permits if required to be obtained by ACED or the construction contractor must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to heritage sites, disturbance of protected vegetation, and disturbance to any riparian vegetation or wetlands.

ASSESSMENT OF IMPACTS: PHASE 2: SOETWATER WIND FARM — CHAPTER 9

Environmental impacts associated with the proposed Soetwater Wind Farm (Phase 2 of the Hidden Valley project) are expected to be associated with the construction, operation and decommissioning of the facility. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts can be expected to vary significantly from site to site.

The construction for a wind energy facility project include land clearing for site preparation and access/haul roads; transportation of supply materials and fuels; construction of foundations involving excavations and cement pouring; compaction of laydown areas and roadways, manoeuvring and operating cranes for unloading and installation of equipment; laying cabling; and commissioning of new equipment. Decommissioning activities may include removal of the temporary project infrastructure and site rehabilitation. Environmental issues associated with construction and decommissioning activities may include, among others, threats to biodiversity and ecological processes, including habitat alteration and impacts to wildlife through mortality, injury and disturbance; impacts to sites of heritage value; soil erosion; and nuisance noise from the movement of vehicles transporting equipment and materials during construction.

Environmental issues specific to the operation of a wind energy facility may include visual impacts; noise produced by the spinning of rotor blades; avian/bat mortality resulting from collisions with blades and barotrauma; and light and illumination issues.

These and other environmental issues were identified through the scoping evaluation. Potentially significant impacts identified have now been assessed within the EIA phase of the study. The EIA process has involved input from specialist consultants, the project proponent, as well as input from key stakeholders (including government authorities) and interested and affected parties engaged through the public consultation process. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts vary significantly from site to site.

This chapter serves to assess the identified potentially significant environmental impacts associated with the proposed wind turbines and associated infrastructure (substation, power line, access road/s to the site, internal access roads between turbines, underground electrical cabling between turbines, turbine foundations), and to make recommendations regarding preferred alternatives for consideration by DEA, as well as for the management of the impacts for inclusion in the draft Environmental Management Programme (refer to **Appendix O**).

In order to assess the impacts associated with the proposed wind energy facility, it is necessary to understand the extent of the affected area. The affected area primarily includes the turbines, substation, overhead power lines and associated access roads. A wind energy facility is dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. The study area for the Soetwater Wind Farm (approximately 95.3 km^2) is being considered as a larger study area for the construction of this phase of the proposed wind energy facility. The area to be occupied by turbines and associated infrastructure is illustrated **in Figure 9.1 (a)** below, and includes the area covered by the following farm portions:

- The remainder of and Portion 1, 2 and 4 of Farm Orange Fontein 203 , and Annex Orange Fontein 185
- Farm Leeuwe Hoek 183
- Farm Zwanepoelshoek

The project will include the following infrastructure:

- Up to 56 **wind turbines**[20], appropriately spaced to make use of the wind resource on the site. The generating capacity of the facility will depend on the final turbine selected for implementation but will be limited to 140MW at the point of connection with the Eskom grid. . The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.
- Each wind turbine is expected to consist of a concrete foundation (20m x 20m), a steel or concrete tower, a hub (between 80m and 120m above ground level, depending on the turbine size decided upon) and three blades with a rotor diameter of up to 120m.
- Cabling between the components, laid approximately 1 m underground where feasible. In as far as possible, cabling will follow the internal access roads[21].
- Internal roads (approximately 8m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines and the vast areas

[20] One turbine was erroneously included in Phase 2 which is now included into Phase 1. Therefore, Phase 1 originally had 75 turbines, and now has 74 turbines. Phase 2 originally had 55 turbines, and now has 56 turbines.

[21] Where underground cabling is not practical or environmentally sensible (e.g. in rocky area where blasting would be required), cabling would be above ground, suspended between ~8m high timber poles at ~60m centres.

of the site which are not currently accessible will necessitate the construction of ~28 km of new access roads in some areas.

» A new 132 kV **substation** and a new 132 kV power line that will connect into a proposed 400 kV substation (located on the Karusa wind farm – Phase 1 of the Hidden valley project). Two alternative substation locations and associated power lines have been considered. This proposed substation complex will have a high-voltage (HV) yard footprint of approximately 200m x 200m.
» **Operations and service building area** for control, maintenance and storage (approximately 2000m^2).
» **Guard house** for access security of 50m$^{2.}$

The assessment presented within this chapter of the report is on the basis of a layout provided by ACED. This layout indicates **56 wind turbines** and associated infrastructure. The assessment of issues presented within this chapter (and within the specialist studies attached within **Appendices F – S**) considers the worst-case scenario in terms of potential impacts. The position of the substation complex (and the alternative power line) is related to the point of connection to the Eskom grid via the Komsberg 400 kV substation). The two alternatives for grid connection are as follows and are shown on **Figure 9.1 (b)**:

» Substation Option 1 is located on Farm Orangefontien. Option 1 is technically preferred.
» Power line Option 1 is 17 km in length and connects Soetwater Substation Option 1 with the preferred 400 kV substation (Karusa Substation Option 1 located on Farm Standvastigheid, on the Karusa site). The power line is proposed to cross the Farms 206, 209 and 207 to connect at the new 400 kV substation located on the Karusa site.
» Substation Option 2 is located on Farm Orangefontien.
» Power line Option 2 is 13 km in length and connects Soetwater Substation Option 2 with the preferred 400 kV substation (Karusa Substation Option 2 located on the Karusa site). The power line is proposed to cross the Farms 185, 202 to connect at the proposed new 400 kV substation complex located on Farm 209 on the Karusa site.

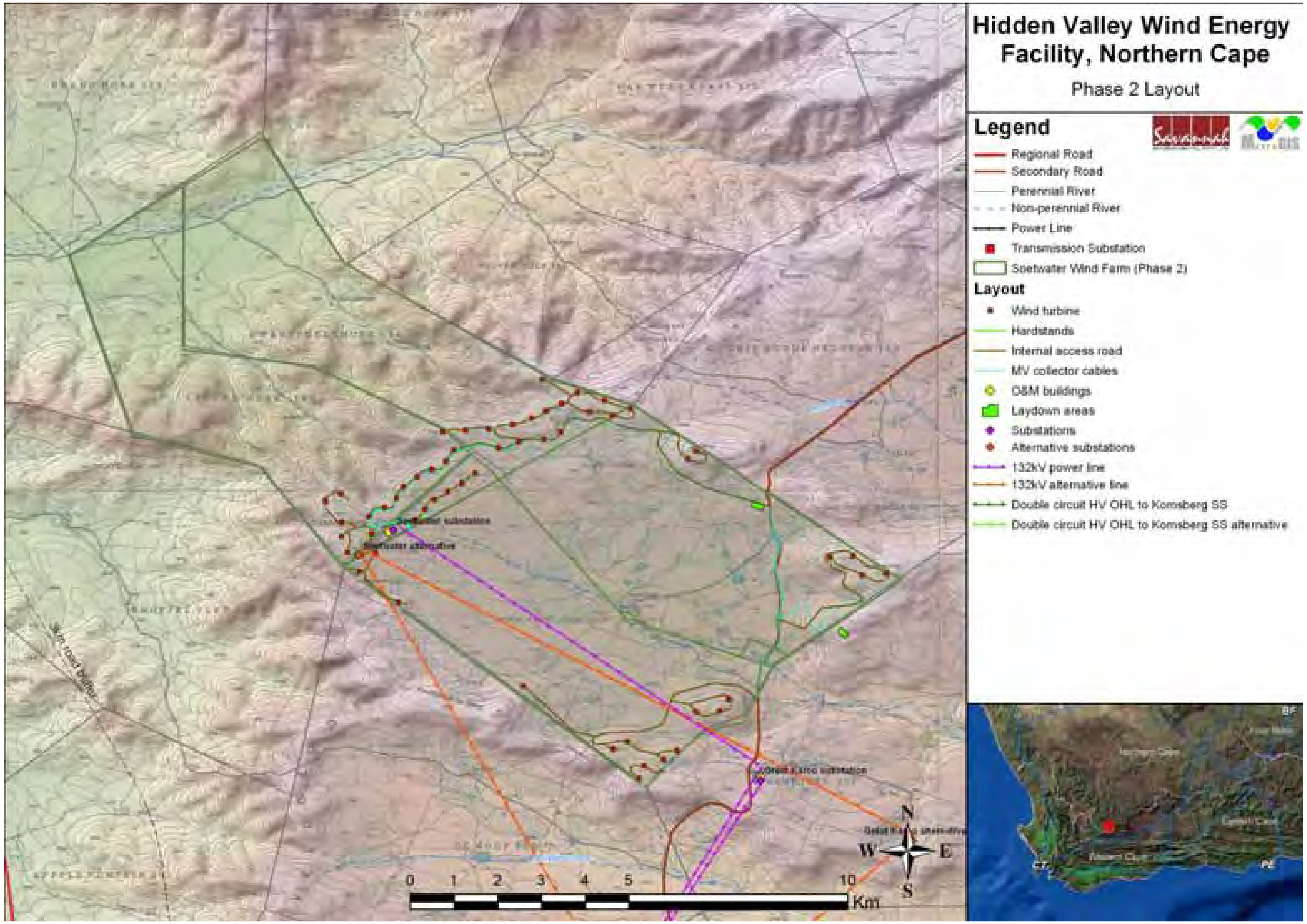

Figure 9.1 (a): Layout of the Soetwater Wind Farm, indicating the cluster of wind turbines to the northern and western portion of the total extent of the site

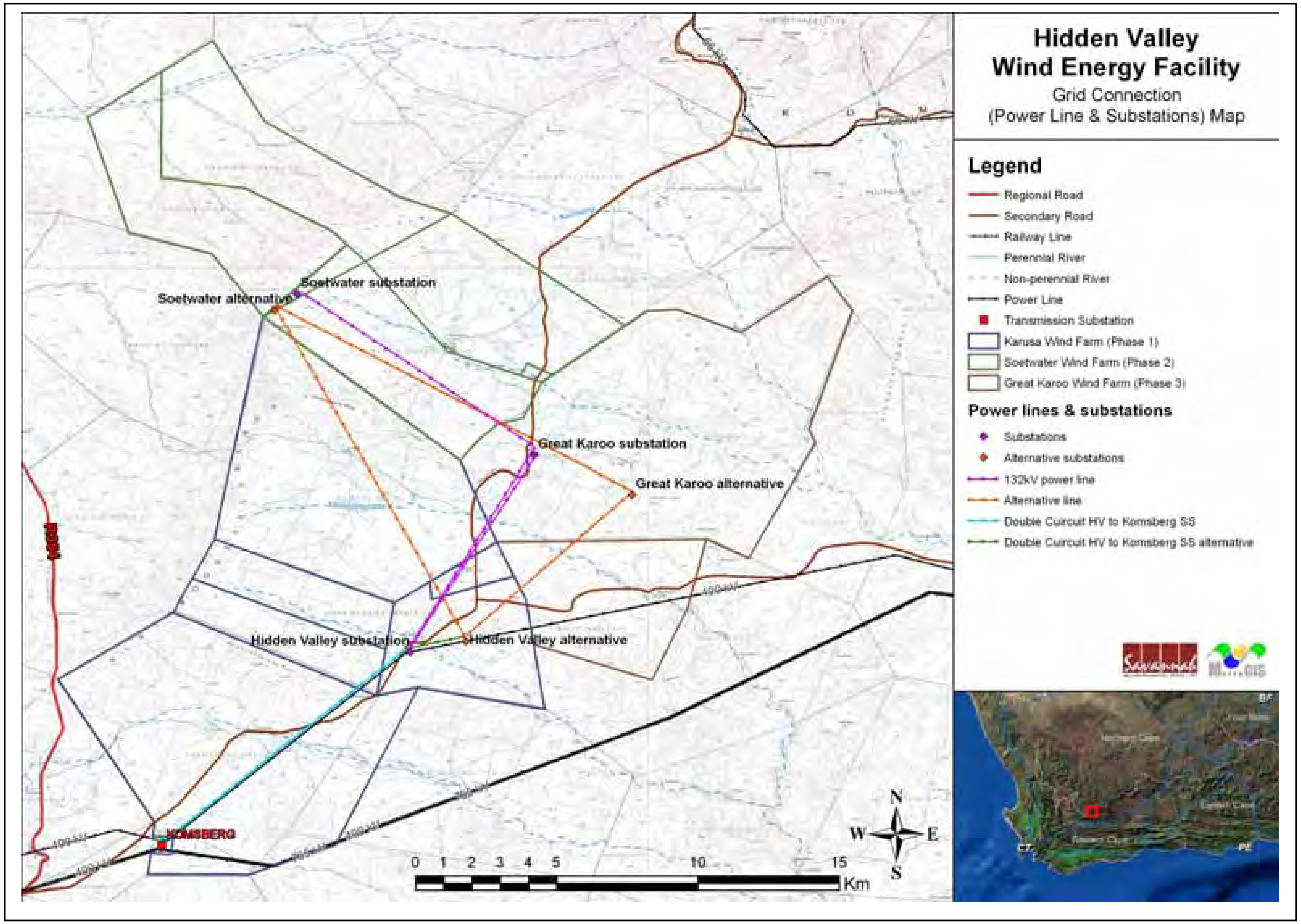

Figure 9.1 (b): Grid Connection – Phase 2 (Soetwater Wind Farm)

9.1 Assessment of Potential Impacts on Ecology

The ecological sensitivity assessment identified those parts of the study area that could have high conservation value or areas sensitive to disturbance. Areas of potentially high ecological sensitivity are shown in **Figure 9.2**. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity. A map of remaining natural habitats and areas important for maintaining ecological processes in the study area is shown in **Figure 9.2**. Relatively fine-scale mapping was used to provide information on the location of sensitive features.

Any natural vegetation within which there are features of conservation concern have been classified into one of the high sensitivity classes (medium-high, high or very high). The difference between these three high classes is based on a combination of factors and can be summarised as follows:

4. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
5. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services.
6. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories.

The following areas occur on the site:

- Vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 (for this site - important terrestrial habitats that are south-facing slopes larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (medium sensitivity).
- Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in natural habitats within the study area.
- Perennial and non-perennial rivers, streams and watercourses (high sensitivity).
- Areas classified as mountains, ridges or steep slopes: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).

Figure 9.2 shows the watercourses and drainage lines and steep slopes to have HIGH ecological sensitivity and conservation value. Natural vegetation on site that occurs within the Hantam-Roggeveld Centre of Plant Endemism (HRC) have MEDIUM-HIGH sensitivity, and other natural vegetation has MEDIUM sensitivity.

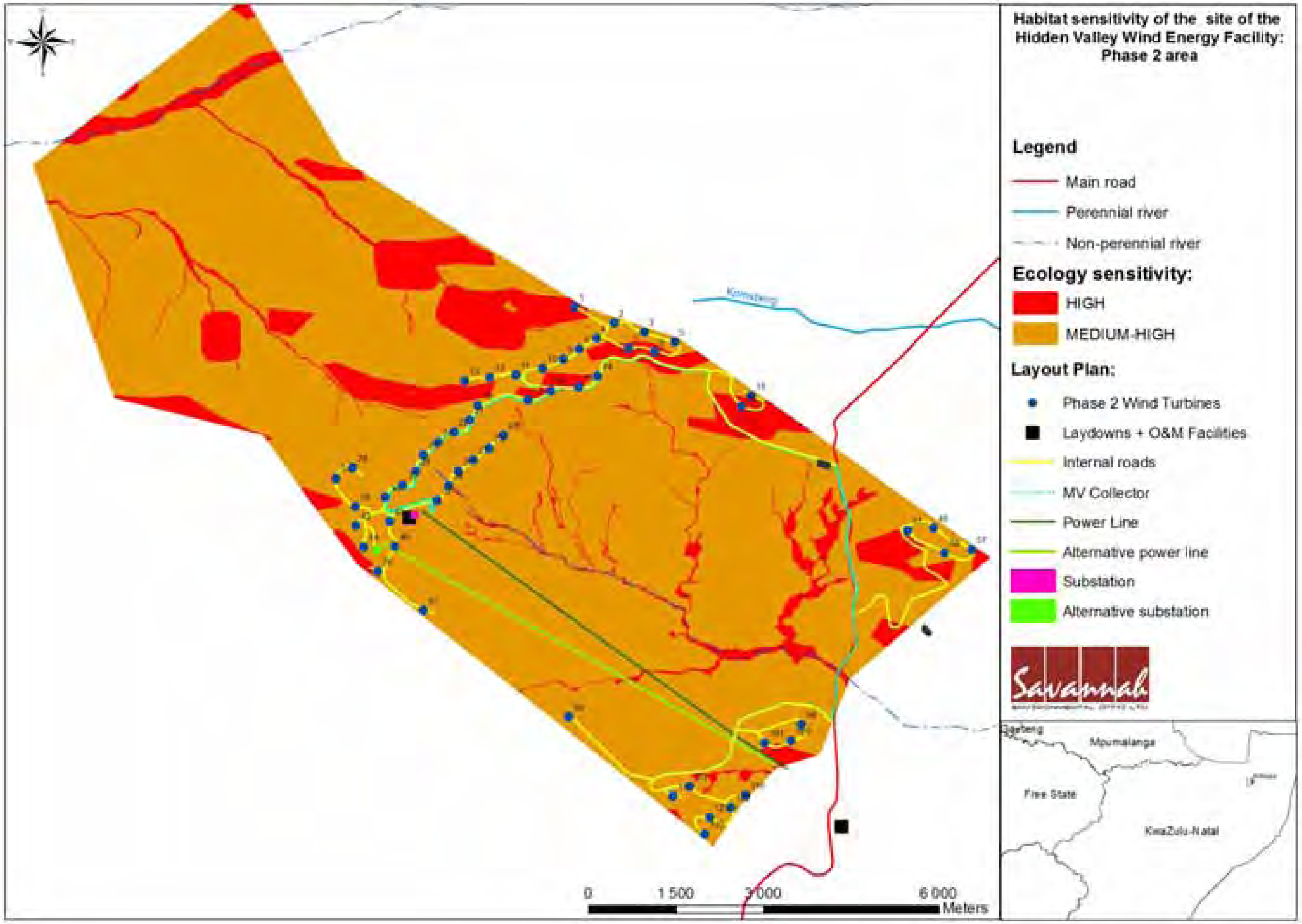

Figure 9.2: Ecological sensitivity map for the Soetwater Wind Farm site, illustrating the location of sensitive vegetation, rivers, wetlands and CBAs

9.1.1 Loss or fragmentation of indigenous natural vegetation

The remaining natural vegetation on site is classified as Least Threatened. However, the site falls within the Cape Floristic Region and the Hantam-Roggeveld Centre of Endemism. It is not expected that turbines structures will have a major effect on natural vegetation, due to the small footprint of each structure, but it is still likely that associated infrastructure such as the access roads and power line servitudes will cause negative impacts (disturbance and loss) on natural vegetation.

Construction of infrastructure associated with the proposed wind energy facility may lead to the direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of vegetation. Where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Consequences of the impact occurring may include:

» negative change in conservation status of habitat (Driver et al. 2005);
» increased vulnerability of remaining portions to future disturbance;
» general loss of habitat for sensitive species;
» loss in variation within sensitive habitats due to loss of portions of it;
» general reduction in biodiversity;
» increased fragmentation (depending on location of impact);
» disturbance to processes maintaining biodiversity and ecosystem goods and services; and
» loss of ecosystem goods and services.

9.1.1.1 Impact Table - Impact on indigenous natural vegetation types – wind energy facility and associated infrastructure (including access roads, power lines etc)

Nature: **Loss of habitat within indigenous natural vegetation types**		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	low (4)	Moderate to low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of	Yes	Yes

resources?		
Can impacts be mitigated?	Yes	

Mitigation:

(1) Avoid unnecessary impacts on natural vegetation surrounding the turbines or access roads. The construction impacts must be contained to the footprint of the turbine, laydown area and access road.
(2) Avoid unnecessary impacts on natural vegetation within power line servitudes. The construction impacts must be contained to the footprint of the servitude.
(3) Rehabilitate any disturbed areas immediately to stabilise landscapes.
(4) Consider implementing biodiversity offsets, such as stewardship programmes, alien removal or vegetation rehabilitation, to compensate for loss of indigenous natural vegetation.

Cumulative impacts:

Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact on the site.

Residual Impacts:

Some loss of vegetation will definitely occur.

9.1.2. Impacts on threatened plants

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, and possibly even local extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

» fragmentation of populations of affected species;
» reduction in area of occupancy of affected species; and
» loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances.

There are five plant species of conservation concern that have a geographic distribution that includes the site and which have a high chance of occurring in the study area. These include:

» three species classified as Vulnerable (*Romulea eburnea, Lotononis venosa and Geissorhiza karooica*) ; and
» two as Rare (*Cleretum lyratifolium and Strumaria karooica*).

The turbines are positioned in areas where these species are most likely to be found. The site is also the core distribution of these threatened species. Turbines are therefore likely to have an impact of medium significance on populations of threatened or rare plant species.

9.1.2.1 Impact Table - Impact on threatened plants

Nature: Impacts on threatened plants		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Local (1)
Duration	Permanent (5)	Long-term (4)
Magnitude	High(8)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (49)**	**medium (33)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: (6) Disturbance of indigenous vegetation must be kept to a minimum, by relocation of wind turbines and associated infrastructure from areas of high ecological sensitivity as far as possible. (7) Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. (8) Prior to construction and once final infrastructure positions are known, the footprint of each turbine , access road and power line servitude must be searched for populations of potentially affected plant species of concern by undertaking a preconstruction survey for the species of concern should be undertaken in the footprint of proposed infrastructure to determine whether any of these species occur within the footprint ofdevelopment or not. Depending on the density of individuals encountered, infrastructure positions to be modified to avoid important populations. If avoiding populations is not possible and any individuals of threatened species will be destroyed, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species. (9) If any populations are found in these areas, move infrastructure to avoid impact. (10) If not possible to relocate infrastructure, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.		
Cumulative impacts: Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to		

additional impacts that will exacerbate this impact.
Residual Impacts: Will probably be low if control measures are effectively applied

9.1.3 Impacts on Wetlands or Watercourses

Construction may lead to some direct or indirect loss of or damage to seasonal marsh wetlands or drainage lines or impacts that affect the catchment of these wetlands. Without mitigation, this could lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

- increased loss of soil;
- loss of or disturbance to indigenous wetland vegetation;
- loss of sensitive wetland habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
- fragmentation of sensitive habitats;
- impairment of wetland function;
- change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
- reduction in water quality in wetlands downstream of road.

Turbines are not located within wetland areas. This potential impact is therefore not relevant to this infrastructure component and is scores as zero significance. Turbines are not located within wetland areas, but internal access roads linking turbines will probably have to cross wetlands in places.

9.1.3.1 Impact Table - Impact on Wetlands/ watercourses

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Short-term (4)
Magnitude	moderate (6)	minor (2)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
Status (positive or negative)	negative	negative

Reversibility	Irreversible	Reversible to some degree
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation:

» Control stormwater and runoff water and inhibit erosion.
» Disturbed areas must be rehabilitated as soon as possible.
» Align internal access roads so that they branch directly from existing roads and go around wetlands as much as possible. If not possible, then the following measures must also be applied:
» Obtain a permit from DWA to impact on any wetland or water resource.
» Cross watercourses close to existing disturbances.
» Cross watercourses perpendicularly, where possible, to minimize the construction footprint.
» Adequate culvert and/or bridge structures are required at crossings.
» Construction must not cause the width of the watercourse to be narrowed.

Cumulative impacts:

Soil erosion, alien invasions, may lead to additional impacts on wetland habitats that will exacerbate this impact.

Residual Impacts:

Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

9.1.4. Impacts on threatened animals and associated habitat

Potential negative impacts on populations are only likely for threatened species, which are the Riverine Rabbit and the Armadillo Girdled Lizard. Loss of habitat is the most important negative impact, which will occur primarily during the construction phase of the project. Turbines affect very little natural habitat and are not within areas considered suitable for the Riverine Rabbit. The known distribution of the riverine rabbit does not include the Soetwater site, as shown in **Figure 9.3.**

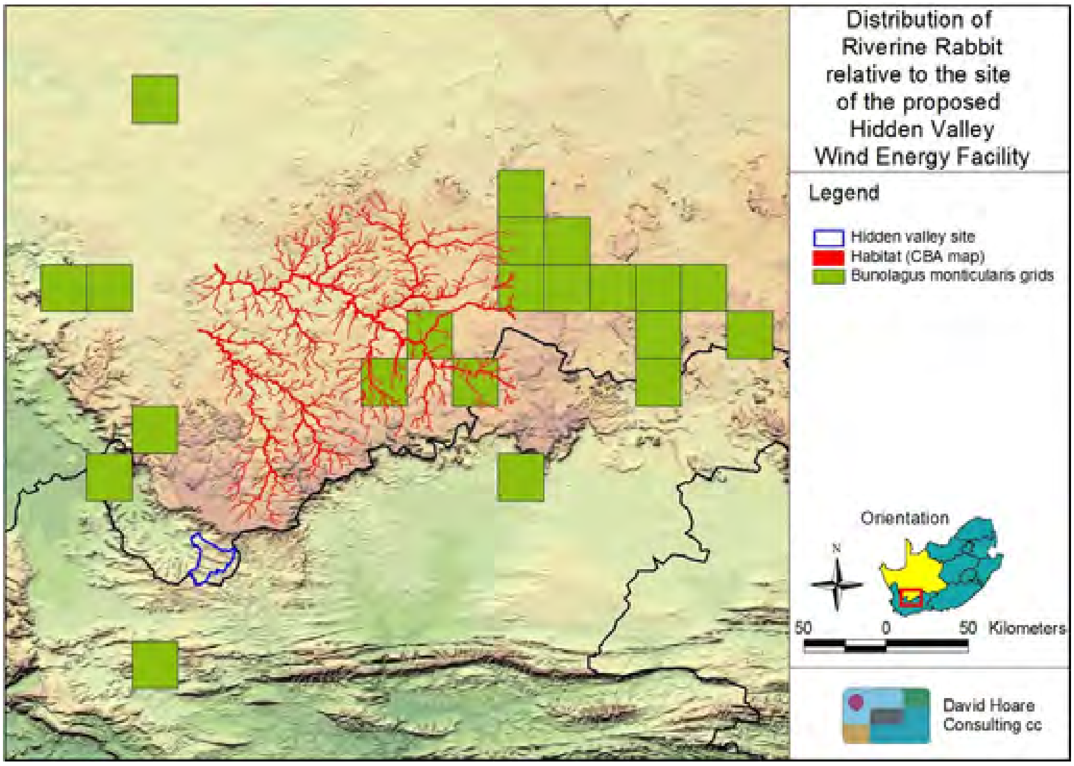

Figure 9.3: Known distribution of the Riverine Rabbit relative to the site.

Threatened animal species are affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species, and possibly even local extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

» fragmentation of populations of affected species;
» reduction in area of occupancy of affected species; and
» loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances. It is improbable that the impact will occur (it is not known whether the species of concern, the Riverine Rabbit and the Armadillo Girdled Lizard, will be affected or not - if they occur it is highly improbable that they will be affected).

Based on the proposed position of turbines, no highly suitable habitat will be affected.

9.1.4.1 Impact Table - Impact on threatened animals / habitat

Nature: Impacts on individuals of threatened animal species		
	Without mitigation	**With mitigation**
Extent	local (3)	local (3)
Duration	permanent (5)	permanent (5)
Magnitude	low (4)	low (4)
Probability	Highly improbable (1)	improbable (2)
Significance	**low (12)**	**low (12)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	yes	
Mitigation: (3) Undertake a walk-through survey of areas with sandy soils once final infrastructure positions are known. (4) If any threatened animal populations are found in these areas, move infrastructure to avoid impact as far as possible.		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions) may exacerbate this impact.		
Residual Impacts: Unlikely to be residual impacts.		

9.1.5. Establishment of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes high disturbance. Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

» loss of indigenous vegetation;
» change in vegetation structure leading to change in various habitat characteristics;
» change in plant species composition;
» change in soil chemical properties;
» loss of sensitive habitats;

- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- change in flammability of vegetation, depending on alien species;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of wetland function.

There are very few concentrations of alien plants on site and habitat is in a natural state. Turbines will create areas of disturbance that will provide conditions in which alien plants are more likely to spread and thrive. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will enhanced by construction of turbines on site. A checklist of species previously recorded in the grid in which the site is located indicates that the following species are likely to invade the site, given the right conditions the following (*Salsola kali, Atriplex lindleyi, Opuntia ficus-indica, Opuntia imbricata, Prosopis glandulosa, Prosopis velutina, Atriplex numularia, and Nicotiana glauca).* The invasion of watercourses by alien plants is noted as a biodiversity issue of particular concern in the Namakwa District Biodiversity Sector Plan.

The wind turbine, substation, access roads and other infrastructure will create new nodes of disturbance within an otherwise undisturbed landscape. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will be enhanced.

9.1.6.1 Impact Table - Alien vegetation growth due to disturbance

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	long-term (4)
Magnitude	moderate (6)	Minor (2)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Keep disturbance of indigenous vegetation to a minimum. » Rehabilitate disturbed areas as quickly as possible » Do not translocate soil stockpiles from areas with alien plants » Control any alien plants, especially within wetlands and watercourses » establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

9.1.6. Vegetation and habitat Loss due to Access Roads

The construction of new access roads to the site and to each wind turbine has the potential to result in negative impacts on ecology. Access roads will entail clearing of vegetation, therefore vegetation loss and habitat loss for plant species. Creation of access roads causes nodes of disturbance, and may become hotpots for soil erosion. This impact could occur on the site, and presents a risk particularly on steep slopes and hills, where turbines are proposed. Some access roads may inevitably cross drainage lines, which may cause downstream effects on watercourse, cumulatively. Therefore the impact of access roads, without environmental control measures may be of a moderate significance and with mitigation this impact could be manageable.

9.1.6.1 Impact Table – Impact of access roads on ecology

Nature: Loss of habitat within indigenous natural vegetation types, disturbance and soil erosion due to creation of permanent access roads.		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	Permanent (5)	permanent (5)
Magnitude	moderate (6)	Moderate (5)
Probability	definite (5)	probable (3)
Significance	**medium (60)**	**medium (33)**
Status (positive or negative)	negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » Internal access roads must make use of existing roads on site, as far as possible. Where new roads are to be constructed, these should follow existing tracks or disturbed areas or the edges of disturbed areas » Avoid unnecessary impacts on natural vegetation surrounding the turbines. The construction impacts must be contained to the footprint of the turbine and laydown area. » Disturbed areas must be rehabilitated as quickly as possible		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of natural vegetation type is likely to occur, but only a small extent is potentially at risk.		

9.1.7. Comparative Assessment of Grid Connection Options

Both grid connection options traverse a drainage line on Portion 1 of Farm Orangefontein. However, due to the power line being able to splan a drainage line, as well as the servitude (width of a 132kV servitude being ~36m) being a tight of way only, this is not considered to be a major issue. Both power line and substation options occurs in areas of medium ecological sensitivity. Therefore both grid connection options will have a similar impact on the ecological environment. With the use of mitigation measures during construction, both grid connection options are acceptable, with no preference from an ecological perspective.

9.1.8. Cumulative impacts

To some extent a cumulative impact is a regional impact, rather than the local site scale impact, i.e. if something has a regional impact it also has a cumulative impact. Cumulative impacts for this assessment will include any approved wind energy facilities in the area. The cumulative impact of the Soetwater Wind Farm has been considered two levels:

» Firstly, impacts of the Soetwater Wind Farm plus the other two development phases of the Hidden Valley project (i.e. Phase 1 and Phase 3).
» Secondly, the additive impact of this project and other approved wind projects within a 10 – 20 km radius of the site. Based on the information available at the time of undertaking this EIA, four wind energy facilities have an environmental authorisation and occur in close proximity to the Hidden Valley site which area listed in Table 9.1 below:

Table 9.1: Proposed Wind Projects in the Study Area

Wind Farm (Developer)	**No. of turbines**	**Distance (km)**	**Status of the development**	**DEA Reference Number**
7. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Roggeveld	Authorisation received	12/12/20/1783
8. Witberg Wind Farm (G7 Renewable Energies)	Up to 27	Approx. 25km south of Roggeveld	Authorisation received	12/12/20/1966
9. Sutherland (wind and solar) (Mainstream SA)	293 to 386	Approx 35km north east o/f Roggeveld	Authorisation received	12/12/20/1782
10. Suurplaat Wind Farm 11. (Moyeng Energy)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received	12/12/20/1583
12. Roggeveld Wind Farm	Approximately 207	Adjacent to the Hidden Valley site (to the west)	EIA in process	12/12/20/1988/1-3
13. Gunstfontein	Approximately 100	Adjacent to the Hidden Valley site (to the north)	EIA in process	14/12 /16/3/3/2/399 (wind) 14/12/16/3/3/2/395 (solar)

Cumulative ecological impacts are expected to be of a moderate significance and include cumulative loss of biodiversity (particularly for protected plants and animal species and soil erosion), and can be effectively mitigated through sound environmental management (mitigation measures) during construction and operation covered in the EMPr and by formal conservation and active management of the natural areas on site. With the implementation of this mitigation, cumulative impacts on ecology as a result of the establishment of various wind energy facilities in the area could be of an acceptable level.

Cumulative effects are however highly uncertain due to the complexities of wind farm development and the likelihood that not all planned wind farms in the area will ultimately be constructed.

9.1.9. Conclusions and Recommendations

The overall impacts of this proposed project are of low or moderate significance in most cases, but of potentially high significance on populations of threatened plant species due to the proposed location of selected turbines in areas of potentially high sensitivity. With mitigation measures implemented, it should be possible to reduce all negative impacts to low significance, except on populations of threatened plants and on natural vegetation, where the impact is likely to remain of medium significance. Potential impacts on vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2, habitat for threatened plants and animals, wetlands / water courses and non-perennial rivers occur on the site, particularly in areas of High sensitivity which are indicated in **Figure 9.3**. These are not necessarily “no-go” areas, but areas of high ecological sensitivity. If impacts on threatened and protected species are managed, it should be possible to develop within these areas of high sensitivity. However, it is recommended that wetlands / watercourses should be avoided as far as possible.

The following pertinent recommendations are made:

» A comprehensive search for threatened and near-threatened plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure is known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate infrastructure, a permit may be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.

» Consider implementing biodiversity offsets, such as stewardship programmes, alien removal or vegetation rehabilitation, to compensate for loss of indigenous vegetation.
» Establish an on-going monitoring programme to detect and quantify any alien plant species that may become established as a result of disturbance.
» Implement mitigation measures as stipulated in the EMPr
» Appoint an ECO during construction.

9.2 Assessment of Potential Impacts on Avifauna

The findings of the pre-construction bird monitoring programme have been incorporated into this section, supplementary to the avifaunal impact assessment (EWT, February 2012).

The effects of a wind energy facility on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss causes a reduction in birds using an area which might then reduce the risk of collision). The principal areas of concern are:

» Bird Mortality due to collision with the wind turbines.
» Displacement due to disturbance and Habitat loss due to the footprint of the wind farm.
» Bird mortalities from collisions with the associated power lines.
» Electrocution of birds by power lines.

Based on the pre-construction bird monitoring programme, sixteen (16) priority bird species were identified on the site including:

» African Harrier-hawk
» Amur Falcon
» Black-shouldered Kite
» Blue Crane
» Booted Eagle
» Gabar Goshawk
» Jackal Buzzard
» Lanner Falcon
» Ludwig's Bustard
» Martial Eagle

- Rock Kestrel
- S. Pale Chanting Goshawk
- Southern Black Korhaan
- Steppe Buzzard
- Verreauxs' Eagle
- Yellow-billed Kite

The Avifaunal Impact Assessment study (EWT 2012) presented avian sensitivity maps, which were generated using site visit information, aerial imagery, and vegetation, and avifaunal habitat mapping. This information was used to determine the avian risk maps developed for the pre-construction bird monitoring report. The EWT recommended exclusion zones for Hidden Valley site and the original turbine layout is shown in Figure 9.4.

The sensitivity categories were assigned using the following factors:

- High sensitivity: The high sensitivity zones include the Rivers and Streams in the study area buffered by 150m on either side, ridge buffers were not included on the map as flight data was used instead. These zones represent potential high sensitivity areas. These areas should be considered in the final layout of the facility and when positioning the wind turbines. However, it is strongly recommended that current turbine positions within these zones be moved, especially those along ridge edges, which should be moved 100m (or more) back from the ridge edge. Associated infrastructure, including roads, power lines and buildings, should avoid these zones. The confidence with which these “High sensitive” areas were identified was medium, and the extent of these zones are indicated in the flight models below with high likelihood ratings.
- Medium Sensitivity: The medium sensitivity zones identified are farm dams as well as certain low risk ridges. These dams and ridges were primarily identified at a desk top level while the presence of a few were confirmed during the site visit as being potentially important to avifauna. However construction of infrastructure may be possible, with caution, in these areas with medium likelihood.
- Low Sensitivity: These are the remaining areas with little likelihood. No obvious avifaunal features or patterns could be identified during the study. However some areas could be designated as Medium in the future upon availability of new data and/or after additional site analysis or pre-construction monitoring. At this there is no proven reason that infrastructure should not be built in these areas. Therefore, these Low sensitivity areas are preferred for construction, particularly of early phases.

Based on the results of the pre-construction bird monitoring five (5) wind turbines from the original layout (6, 20, 31, 28, 33) falls within the high risk areas for avifauna. These turbines should be relocated to areas outside of the high risk areas as shown in Figure 9.4 and as informed by the pre-construction bird monitoring study. The applicant has thus adhered to the recommendations made by the avifaunal specialists and no turbines are placed within high risk areas. This is shown in discussed in more detail in the conclusions chapter 10. .

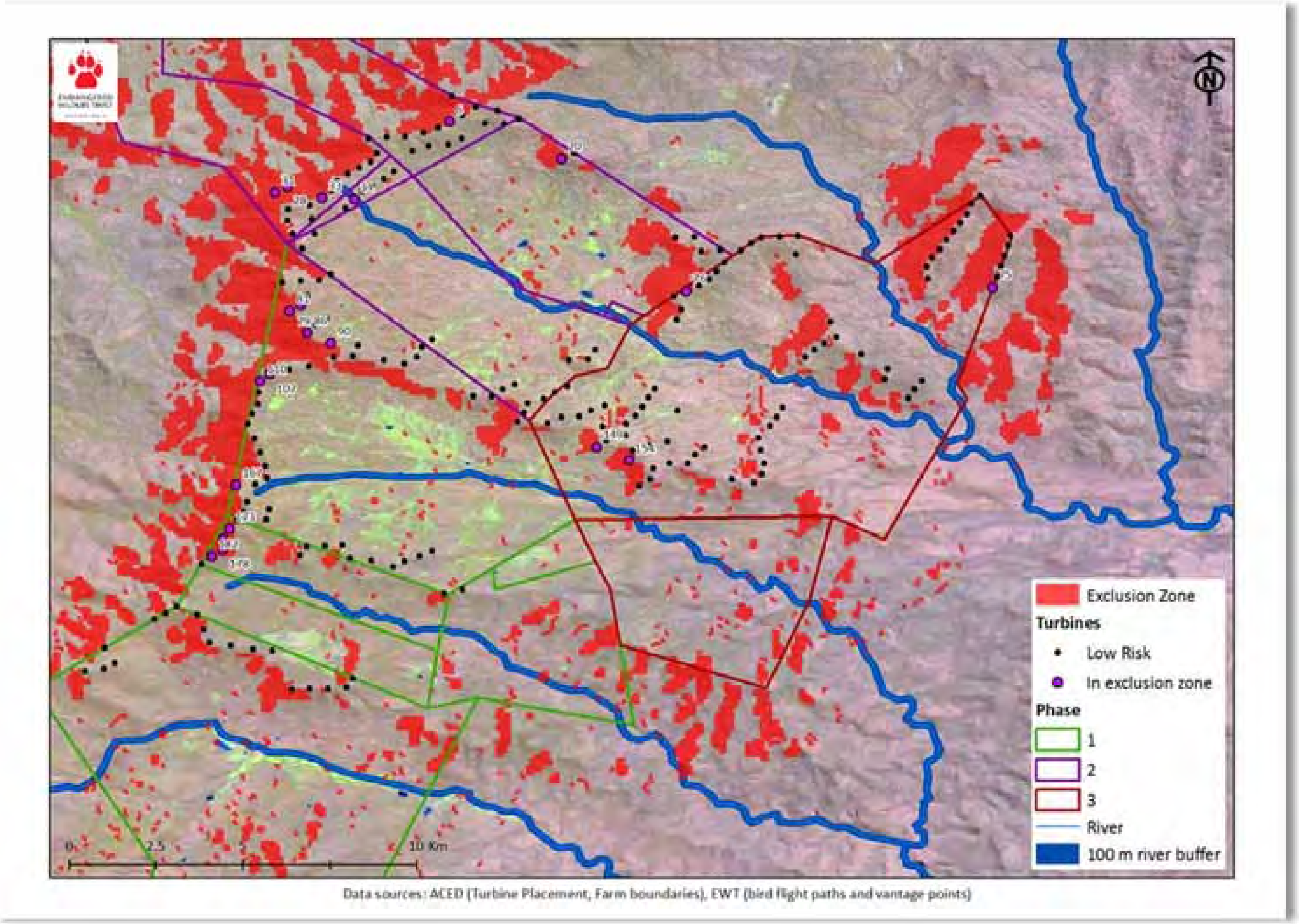

Figure 9.4: EWT recommended exclusion zones for Hidden Valley site and the original turbine layout

9.2.1 Bird Mortalities due to collisions with wind turbines

The three main hypotheses proposed for birds not seeing turbine blades are as follows (Hodos, 2002):

» An inability to divide attention between prey and obstacles. This seems an unlikely explanation as birds have been found to maintain good acuity in the peripheral vision, have different foveal region in the eye for frontal and ground vision and they have various other optical methods for keeping objects at different distances simultaneously in focus.
» The phenomenon of motion smear or retinal blur, explained earlier in this report.
» The angle of approach. If a bird approaches from side on to the turbine, the blades present a very small profile and are even more difficult to detect.

9.2.1.1 Impact Table - Bird Mortalities due to collisions with wind turbines

Nature of the Impact: Collision of birds with turbines at Soetwater Wind Farm.		
	Without Mitigation	**With Mitigation**
Extent	Site- Impact will occur locally, but have national implications for certain species (2)	Site- Impact will occur locally, but have national implications for certain species (2)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Very high (10)
Probability	Probable (3)	Probable (3)
Significance	**Medium (48)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Partially	
Mitigation » The most important mitigation option is the correct positioning of turbines outside of the identified high sensitivity zones, and where possible, outside of the medium sensitivity zones. This micro-siting has already done during the feasibility phase of this project and the high risk turbines are to be moved into medium/low sensitivity areas. » A post-construction bird monitoring program will be vital to determine additional mitigation measures or the behaviour of the bird species. » Additional available or potential mitigation options therefore would need to be employed		

once the turbines are already operational, if monitoring reveals significant impacts. » Some mitigation options that can be employed if monitoring reveals significant numbers of collisions, include: that one blade be painted black, in order to provide an alternating image for the bird in flight; curtailment, i.e. shutting down certain turbines at certain times; manipulation of blade height to accommodate predominant bird flight height, and any others that may be identified as our understanding of the impacts progresses.
Cumulative impacts The cumulative impact of bird collisions in the may be significant if mitigation measures are not followed. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with overhead cables in the area. If other proposed wind projects in the broader area are built, they may further impact on these target species' populations. An additional mortality factor such as collision with turbines may prove detrimental to local populations of these species.
Residual impacts None

9.2.2 Displacement of Birds due to Disturbance and habitat loss

During the construction phase some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, through the modification of habitat. During the construction and maintenance of electrical infrastructure, a certain amount of disturbance also results. For shy, sensitive species this can impact on their usual daily activities, particularly whilst breeding.

9.2.2.1 Impact Table - Impact on birds due to disturbance

Nature of the Impact: Disturbance and habitat loss of birds during construction of Soetwater Wind Farm		
	Without Mitigation	**With Mitigation**
Extent	Local – site & immediate surrounds only (2)	Local – site & immediate surrounds only (2)
Duration	short term (2)	short term (2)
Magnitude	moderate (6)	moderate (6))
Probability	highly probable (4)	probable)3()
Significance	**Medium (40)**	**Medium (30)**
Status (positive or negative)	Negative	Negative

Reversibility	Medium	High
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Partially	
» Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff. » Avifaunal sensitive zones should be avoided where possible. It is difficult to mitigate properly for this as some disturbance is inevitable as a result of the use of equipment and heavy vehicles. » Environmental measures are detailed in the site specific EMP and will be enforced and overseen by the ECO for the project. » During the construction phase a site walkthrough is recommended so that the avifaunal specialist can identify any breeding sensitive bird species in close proximity to specified turbines and associated infrastructure positions. If any of the "Focal Species" identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted for further instruction. » It is recommended that a ridge survey is undertaken for the identification of nesting sites before construction.		
Cumulative impacts Medium – if other sites are being constructed at the same time		
Residual impacts Low		

9.2.4 Collision / Electrocution of Birds by Power line

The proposed 132 kV power line options that will link the wind facility to the grid could pose a collision risk. Because of their length and prominence, power lines constitute an important interface between birds and people.

» ***Collision:*** Collisions of birds with a power line are a threat to birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the result that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

» ***Electrocution of birds by power line:*** This scenario occurs when a bird is perched or attempts to perch on the electrical structure (such as a power line) and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution is possible on 132kV lines or lower. The electrocution risk of the associated overhead power lines can only be assessed once the tower structure to be used is known. Species that could be impacted upon include herons, storks, and some large eagles.

9.2.4.1 Impact Tables – Electrocution of birds with the Power line

Nature of the Impact: Electrocution of birds on associated overhead power lines at Soetwater Wind Farm.		
	Without Mitigation	**With Mitigation**
Extent	2 (Site- Impact will occur locally, but have national implications for certain species)	2 (Site- Impact will occur locally, but have national implications for certain species)
Duration	4 (Long term)	4 (Long term)
Magnitude	10 (Very high)	10 (Very high)
Probability	3 (Probable)	1 (Very improbable)
Significance	**48 (Medium)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation Associated power-lines should be placed underground where possible. Any overhead power lines which are built, and which are above ground and are 132kV or lower, should use a "bird friendly" monopole structure, fitted with a bird perch, as per Eskom standard guidelines.		
Cumulative impacts The power line network in the study area is a source of unnatural mortality for large terrestrial species, specifically Blue Cranes and Denham's Bustard. This power line will further increase the cumulative risk posed by the network.		
Residual impacts Low		

9.2.4.2 Impact Tables – Collision of birds with the Power line

Nature of the Impact: Collision of birds with associated overhead power lines at Soetwater Wind Farm		
	Without Mitigation	**With Mitigation**

Extent	2 (Site- Impact will occur locally, but have national implications for certain species)	2 (Site- Impact will occur locally, but have national implications for certain species)
Duration	4 (Long term)	4 (Long term)
Magnitude	10 (Very high)	10 (Very high)
Probability	3 (Probable)	2 (Improbable)
Significance	**48 (Medium)**	**32 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	*Partially*	
Mitigation Distribution power lines connecting turbines should be placed underground were it is feasible to do so. Mark relevant sections of the overhead power lines (i.e. within the Medium-High Sensitivity zones) with appropriate marking devices. The exact spans will be finalised as part of the EMPr phase (during micrositing/site walkthrough), once power line routes are finalised and pylon positions are pegged.		
Cumulative impacts The cumulative impact of bird collisions in the area is may be significant. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with overhead cables in the area. If additional power lines in the broader are built, they may further impact on these target species' populations.		
Residual impacts Undetermined		

9.2.5 Comparative Assessment of Grid Connection Options

The power line and substation alternatives in relation to the avifaunal sensitivity map are shown in Figure 9.5. Note that the Soetwater power lines connect via Phase 1 (Karusa) power lines and into Komsberg substation. The Soewater Power line Option 1 is 17 km in length and connects to the Soetwater Substation Option 1. The Soewater Power line Option 2 is 13 km in length and connects to The Soewater Substation Option 2. Of the 2 grid connection options, The Soetwater Option substation and power line 2 is slightly preferred. Option 1 is preferred. It is recommended that the lines follow existing fence-lines, roads and farm roads where possible or adhere to exclusions and buffer zones where possible. Mitigation is recommended in this report as followed, i.e. collision mitigation, in the form of "bird flight diverters" is fitted to the required sections of line, which must be identified in a site "walkthrough" prior to construction to position power line towers.

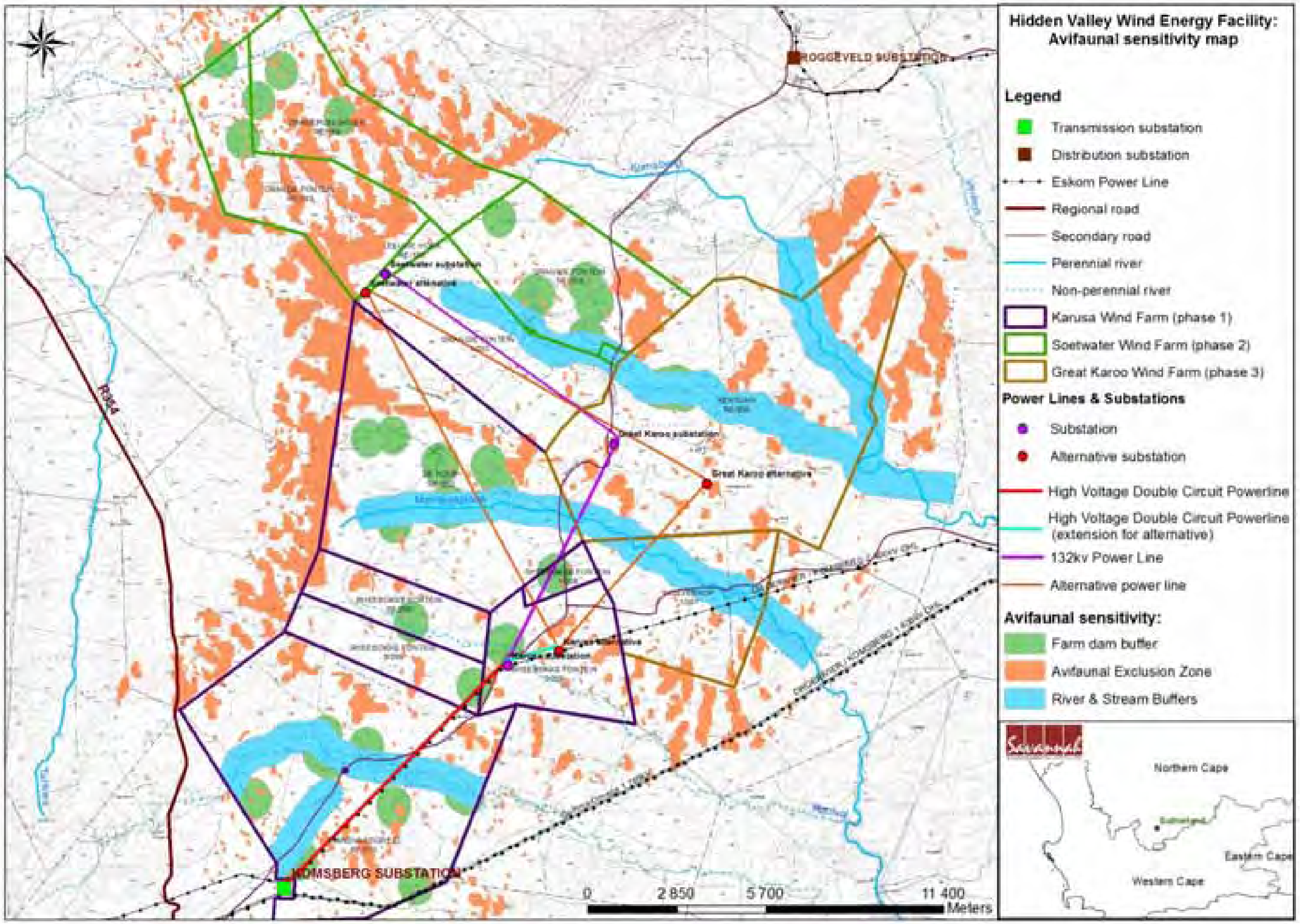

Figure 9.5: Grid Connection Options for Phase 2 (also shown in other Phases) overlain with avifaunal sensitive areas

9.2.6. Cumulative impacts

The cumulative impact of the Soetwater Wind Farm has been considered at two levels:

» Firstly, impacts of the Soetwater Wind Farm plus the other two development phases of the Hidden Valley project (i.e. Phase 1 –Karusa Wind Farm and Phase 3 – Great Karoo Wind Farm). The three –phased development of the Hidden valley project could have cumulative effects facilities on bird species of conservation concern may be moderate to high, without mitigation. However, with mitigation, the cumulative effects will be of acceptable levels.
» Secondly, the additive impact of this project and other approved wind projects within a 10 – 20 km radius of the site. It is impossible to say at this stage what the cumulative impact of all the proposed wind developments in this region of the Northern Cape will have on birds, firstly because there is no baseline to measure it against, and secondly because the extent of actual impacts will only become known once a commercial wind energy facility is developed in South Africa / the Northern Cape. Based on the information available at the time of undertaking this EIA, four wind energy facilities have an environmental authorisation and occur in close proximity to the Hidden Valley site.

The cumulative effect of the four or more approved wind energy facilities, within a10-20 km radius of each other on bird species of conservation concern may be moderate significance. It is therefore imperative that pre-construction and post-construction monitoring is implemented in line with any accepted / endorsed bird monitoring guidelines / standards to provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. This will provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. At this stage, indications are that displacement may emerge as a significant impact, particularly for the target species such as Ludwig's Bustard Black Stork, Southern Black Korhaan, Martial Eagle, Jackal Buzzard, Greater Flamingo, Lesser Kestrel and assorted waterfowl, and waders. In some cases, these species serve as surrogates for other similar species, examples being Lesser Kestrel for Rock Kestrel, and Southern Black Korhaan or Karoo Korhaan.

The cumulative effect of surrounding wind energy facilities with the proposed Hidden Valley wind energy facility will increase the significance of the following impacts:

» Collision with turbines
» Impacts with overhead power lines
» Disruption in local bird movement patterns

The impact tables below are based on the assumption that 50% of the applications for the surrounding farm areas will be approved / have been approved (based on public information of applications).

Nature: Cumulative avian collision with turbines		
	Without mitigation	**With mitigation**
Extent	Medium (2)	Medium (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	High(8)	High(8)
Probability	Probable (3)	Probable (3)
Significance	**Medium (39)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	limited	

Nature: Cumulative Impacts with overhead power lines		
	Without mitigation	**With mitigation**
Extent	High (3)	Medium (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	High(8)	Moderate (6)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (56)**	**Low (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	limited	

Nature: Disruption in local bird movement patterns		
	Without mitigation	**With mitigation**
Extent	High (3)	High (3)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (48)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	no	no
Can impacts be mitigated?	No	

The cumulative impact of bird collisions in the area may be moderately significant should the wind farms ever be developed. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with any existing overhead cables in the area as a result of their flight patterns and physical characteristics. If other proposed wind projects in the broader area are built, they may further impact on these target species' populations. An additional mortality factor such as collision with turbines may prove detrimental to local populations of these species. Additional wind projectswill increase the overall distance and spans of overhead lines in the area to connect with the nearest sub-station.

Cumulative effects are however highly uncertain due to the complexities of wind farm development and the likelihood that not all planned wind farms in the area will ultimately be constructed. Furthermore, with the appropriate pre- and post-construction monitoring potential impacts can be mitigated through correct turbine and overhead line placement as well as overhead line flappers and alike.

9.2.7. Conclusions and Recommendations – Avifauna

» Collision with the turbine blades is likely to be the most significant impact, to which all of the focal species are vulnerable. With a project of this size, habitat destruction may also be significant.
» The proposed site was found to be moderately sensitive in terms of avifauna, with areas of high, medium and unknown sensitivity being present on site and a large number of sightings of priority birds specifically soaring species utilizing the topography on site.
» There are no fatal flaws associated with the site, and the project should proceed subject to the moving of turbines out of high risk areas to areas of lower risk as identified in the pre-construction bird monitoring report.
» Based on the results of the pre-construction bird monitoring five wind turbines of the original layout (6, 20, 31, 28 and 33) falls within the high risk areas for avifauna. These turbines have been relocated to areas outside of the high risk areas as presented in the conclusions chapter (Chapter 10) as informed by the pre-construction bird monitoring study.
» It is recommended that the power – line routes follow existing roads and servitudes and avoid the buffer zones identified.
» An avifaunal "walkthrough" or "micro-siting" site visit is always recommended for power-line alignment and for position of masts.
» Numerous ridges to the west and north of the site represent areas of high sensitivity and it is recommended that turbines be moved out of these zones. In terms of the "no-go" alternative, the current status quo would be maintained by not implementing the proposed wind farms. The current farming activities will continue and the land use will not change. Presence and abundance of bird species, as described in the Avifaunal EIA Report, would remain the same.

Purely in terms of impacts on avifauna, this option would have the least impacts.

- In terms of the substation and power line layout alternatives, substation Option 1 is preferred.
- The EMPr contains a draft operational phase bird monitoring programme.

9.3 Impacts on Bats

9.3.1 Results of the Pre-Construction Bat Monitoring Programme

In order to characterise the bat community (baseline) a pre-construction bat monitoring programme was undertaken at the Hidden Valley Wind Energy Facility site and at a control site by Animalia cc. The bat monitoring report also contains an assessment of the potential impacts of the wind energy facility on bats. The pre-construction bat monitoring and assessment report is attached to Appendix S. The results of the pre-construction bat monitoring to date confirmed that there are three bat species (one specie considered as "near threatened" (the Natal long-fingered bat) and two considered as species of "least concern (the Cape Serotine bat and the Egyptian Free-tailed bat) which occurred at the proposed Hidden Valley wind energy facility site. The bat monitoring study found that high localised bat activity at certain times of the year occurred on the wind energy facility site although not in close proximity to any planned turbine positions.

Figure 9.6 depicts the bat sensitive areas of the Soetwater Wind Farm, based on features identified to be important for foraging and roosting of the species that are confirmed and most probable to occur on site. This map has been used to inform the pre-construction mitigation and planning in terms of improving turbine placement in relation to preferred habitats bat on the site.

In terms of the bat sensitivity map, the following categories have been used:

- Moderate Sensitivity: Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology, with an expected relative higher risk of impacting on local bats. Turbines within or close to these areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and mitigation measures, if any is needed.
- High Sensitivity and their buffers: Areas that are deemed critical for resident bat populations, capable of elevated levels of bat activity and support greater bat diversity than the rest of the site. These areas are 'no-go' areas and turbines must not be placed in these areas.

The following is relevant regarding turbines in relation to the bat sensitivity map:

» Based on the current layout for the Soetwater phase no turbines occur in the areas of high sensitivity.
» No turbines occur in the high sensitivity buffer.
» No turbines occur in the moderate sensitivity area.
» Two turbines (Turbines 34 and 111) occur in the moderate sensitivity buffer.
» Four turbines (73, 204, 205 and 207) occur immediately outside of moderate bat sensitivity buffer.

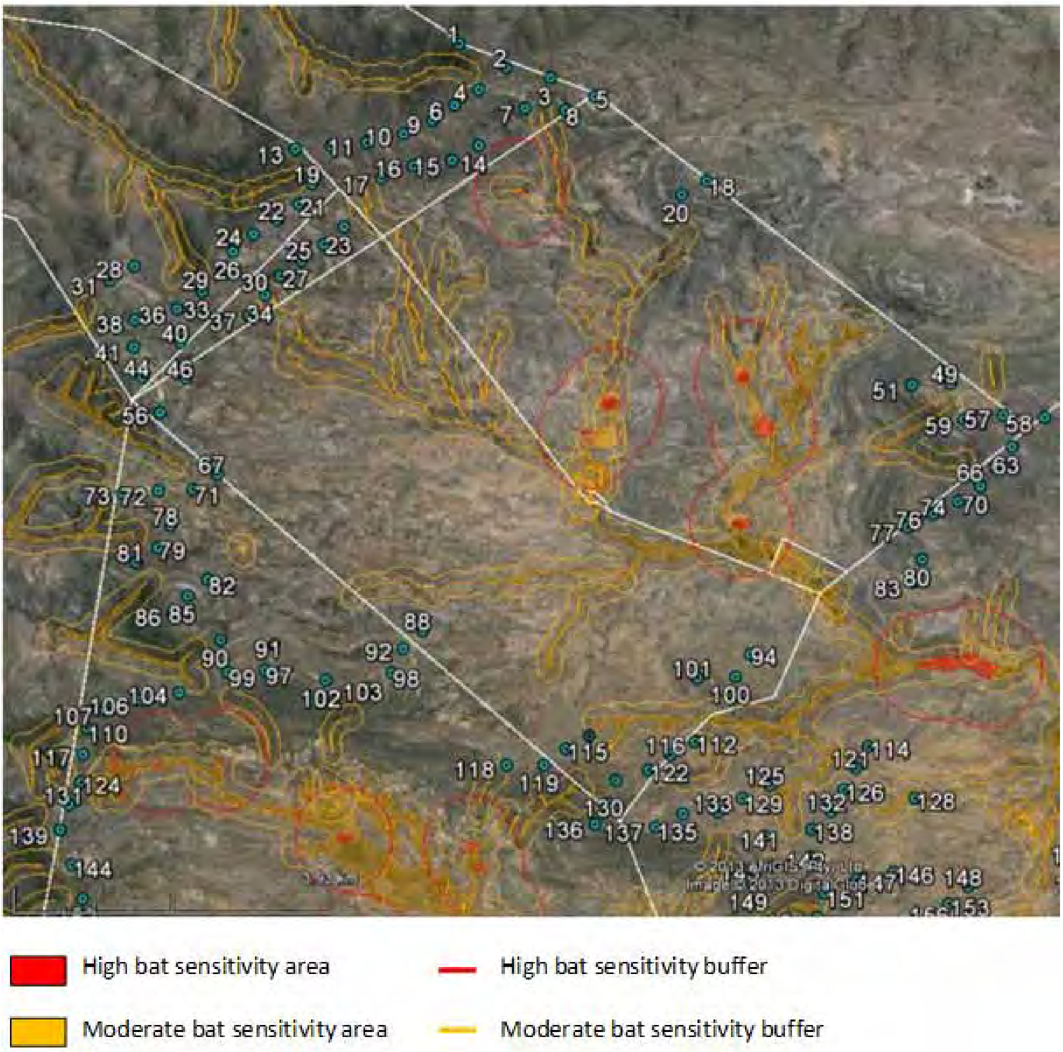

Figure 9.6: Bat Sensitivity map for proposed Soetwater Wind Farm

No movements of turbines or mitigations are required since turbines are placed outside of bat High sensitive areas or their buffers. However while not essential it is recommended to move turbines, if possible, out of moderate sensitivity areas to minimise risk of impact on bats. This has been undertaken and a revised layout is presented in the conclusions chapter. The impact of the wind turbines for the Soetwater Wind Farm on bats is expected to be low significance. Due to the low bat activity recorded by passive systems on this phase confidence in the impact statement is high.

9.3.2 Impact Tables summarising impacts on bats

Wind turbines can cause bat mortalities due to collision of bats with the wind turbine blades, however more often due to barotrauma. Barotrauma refers to bat deaths due to tissue damage to air- containing structures caused by rapid or excessive pressure change close to the rotating wind turbine blades surface. Death is usually caused by pulmonary barotrauma where lungs are damaged due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald et al., 2008). The potential collision risk is not the same for all bat species and it varies according to the species' habits and ecology. Construction may result in habitat loss of based, which is also assessed in the tables below.

Nature: Bat mortalities due to direct blade impact or barotrauma during foraging (not migration) Turbines are proposed mostly on the western ridge where bat activity is relatively low based on the passive detection results. However a large central area acts as a catchment and drainage system with multiple areas that can support lasting moisture, this in turn can attract insects and insectivorous bats to the drainage area. These areas have been demarcated in the sensitivity map and no turbines are proposed in such areas under the current facility layout. High and Moderate sensitivity zones are avoided and turbines have also been moved out of buffer zones as mitigation.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium(33)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: Adhere to the sensitivity map during any further turbine layout revisions, and preferably do not move any turbines into even Moderate sensitivity areas.		
Cumulative impacts considering the other 2 phases: Because the three phases are located directly adjacent each other, if turbines are placed in areas of bat sensitivity the effect of the impact will be amplified across the entire Hidden Valley project. Since the species of concern are insectivorous and the only major predator of nocturnal flying insects, they contribute significantly to the local ecology. Therefore if significant numbers of bats are		

killed off insect numbers across the site will elevate as a zone favourable to insects is created across the larger area of the three phases.

Nature: Bat mortalities due to direct blade impact or barotrauma during migration Migratory routes in the region are completely unknown, and there is no knowledge of whether any such migrations exist. But no known caves capable of providing roosting space for migratory species are known to occur in the area. The migratory species *M. natalensis* have been detected in very low numbers on this phase. However, no bat migrations have been detected and the migratory species are present in very low numbers on the site.		
	Without mitigation	**With mitigation**
Extent	Medium (3)	Medium (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (13)**	**Low (11)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: Continue monitoring of passive data to determine if migrations occur on site or not. If migrations occur affected turbines must be relocated on the layout before construction as to avoid impact to the migrating bats, or curtailed accordingly to avoid impact to migrating bats		
Cumulative impacts considering the other 2 phases: If a migratory route is present through all three phases the probability of migrating bats being impacted by turbines is higher than with a single phase. But no migrations have been detected and the migratory species are only present in very low numbers on all three phases.		

Nature: Destruction of bat roosts during construction Possible roosting spaces on site are mostly in the form of rock crevices where water erosion has exposed rock on hill slopes. Water drainage areas are demarcated in the sensitivity map and turbines are proposed in areas where multiple crevice roosts are unlikely.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (8)**	**Low (8)**
Status (positive or negative)	Negative	Negative
Reversibility	Very low	Very low

Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » Adhere to the sensitivity map.		
Cumulative impacts considering the other 2 phases*:* Because the three phases are located directly adjacent each other, if turbines are placed in areas of bat sensitivity the effect of the impact will be amplified across the entire Hidden Valley project. Since the species of concern are insectivorous and the only major predator of nocturnal flying insects, they contribute significantly to the local ecology. Therefore if significant numbers of bats are killed off insect numbers across the site will elevate as a zone favourable to insects is created across the larger area of the three phases.		

9.3.3 Comparative Assessment of Substation Alternatives

There will be no differences in the significance of impacts on bats for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable.

9.3.4. Cumulative impacts

Based on the information available at the time of undertaking this EIA, four wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site and there are other wind projects proposed in the area. Note that currently none of these projects are preferred bidders yet. Mortalities of bats due to multiple wind turbines in an region during foraging and migration can have significant ecological consequences as the bat species at risk are insectivorous and thereby contribute significantly to the control of flying insect at night. On a project specific level insect numbers in a certain habitat can increase if significant numbers of bats are killed off. But if such an impact is present on multiple projects in close vicinity of each other, insect numbers can increase regionally and possibly cause outbreaks of colonies of certain insect species. It is therefore essential that project specific mitigations be applied and adhered to for individual wind energy facilities, as there is it not possible to implement or advocate overarching mitigation on a regional level. Additionally if migrating bats are killed, it can have detrimental effects on the cave ecology of both caves that a specific colony utilises. This is due to the fact that bat guano are the primary form of energy input into a cave ecology system as no sunshine that allows photosynthesis exists in cave ecosystems. Cumulative impacts on bats due to multiple wind energy facilities in the region will be of a medium significance if project specific mitigations being implemented for each project.

9.9.4. Conclusions and Recommendations

Overall the proposed turbine positions for the Soetwater phase have low bat activity. The impact on bats is expected to be low. This statement carries the proviso that if subsequent layout revisions are required these adhere to the sensitivity map. No discoveries on site or in the data have been found that dictates the need to withhold environmental authorisation of the wind energy facility due to potential impacts on bats. It is recommended bat monitoring during the operational phase is carried out for the wind farm and that this is a condition of environmental authorisation.

9.4 Assessment of Potential Impacts on Soil, Land Use, Land Capability and Agricultural Potential

The soil excavations, construction of turbines, buildings, roads and power lines could lead to physical degradation of soil. During the operation of the wind energy facility soil impacts could include soil contamination / soil erosion by vehicles doing maintenance on site.

9.4.1 Impact on the project on Agricultural Potential

The site is located in an arid region of the Northern Cape. The agricultural potential of the Soetwater Wind Farm site is very low due to soil and climatic constraints. The low agricultural potential of the site is the result of the dominance of shallow and rocky soils. There are no areas of irrigated agriculture on the site, only grazing of livestock (cattle and sheep). The only soils that are suited to agricultural production are found in the valley bottoms. These will not be impacted by the construction of wind turbines. The areas covered in shallow soils are considered to be suitable only to extensive grazing. This grazing potential is low due to vegetative cover and low biological (biomass) productivity. In addition, the rest of the site which is not occupied by wind turbines and other infrastructure will be able to continue the current land-use i.e. livestock grazing. Therefore the impact of the wind energy facility on agricultural potential of a low significance.

9.4.1.1 Impact Table - Agricultural Potential

Nature of Impact: Loss of land with high agricultural potential and land capability due to the development of the wind energy facility		
	Without mitigation	***With mitigation***
Extent	Low (1) – Site	Low (1) – Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)

Significance*	**16 (Low)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Direct impacts cannot be mitigated but indirect impacts can be minimised and avoided through adequate planning of layout	
Mitigation: The loss of agricultural land is a long term loss and there are no mitigation measures that can be put in place to combat this loss. Mitigation is restricted to the limitation of the extent of the impact to the immediate area of impact and minimisation of off-site impacts.		
Cumulative impacts: Soil erosion may arise due to altered surface water runoff. Adequate management and erosion control measures should be implemented.		
Residual Impacts: The loss of agricultural land is a long term loss, however limited an arid are of low agricultural potential and to the footprint of the wind turbine and infrastructure will occupy a minimal percentage of the land, and that agriculture can still continue on the rest of the farm (not occupied by infrastructure for the facility). This loss extends to the post-construction phase albeit of a low to negligible significance.		

9.4.2 Soil Erosion / Degradation during Construction

Soil erodability – the susceptibility of soil to erosion – is a complex variable, not only because it depends on soil chemistry, texture, and characteristics, but because it varies with time and other variables, such as mode of transport (i.e. wind or water). The erodibility of the soils on the site is associated with the sparse vegetation cover, thin soil profiles and steep slopes that characterise it. Soil degradation is the negative alteration of the natural soil profile, usually directly or indirectly related to human activity. Soil degradation due to construction activity will negatively affect soil formation, natural weathering processes, moisture levels and soil stability. This will, in turn, affect biological processes operating in the soil. Soil degradation includes erosion (i.e. due to water and wind), soil removal, mixing, wetting, compaction, pollution, salinisation, crusting, and acidification.

Soil erosion is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of *inter alia* chemical processes and/or physical transport on the land surface. Soil erosion can be accelerated by human activity is termed “accelerated erosion”.

Erosion of soil due to water run-off is generally considered as more important due to the magnitude of the potential impact over a relatively short period of time which can be very difficult to control. Erosion by water occurs when the force exerted on the soil by flowing water exceeds the internal shear strength of the soil and the soil fails and becomes mobilised into suspension. Erosion potential is typically increased in areas where soil is loosened and vegetation cover is stripped (e.g. construction sites). Erosion sensitivity can be broadly mapped according to the severity of the potential erosion if land disturbing activities occur and this is generally related to the geology, soil types and the topography. Generally speaking, thick accumulations of unconsolidated or partly consolidated fine-grained soils of low plasticity along drainage lines and on moderate to steep slopes or at the base of steep slopes are most vulnerable to severe levels of erosion due to water run-off. These areas are typically called "highly sensitive" areas. Loose soil may also cause dust, relating to access roads and the use of vehicles on the site.

Specifically relating to the site in question, there are steep slopes within the site development footprint (refer to **Figure 9.7),** and the location of turbines on these steep slopes may cause accelerated erosion, in the absence of mitigation measures to prevent soil poison, particularly during construction. If soils are well managed during the construction and operational life of the facility, soil erosion / degradation or loss will not be a significant negative impact.

Figure 9.7: Slope map for the Soetwater Wind Farm site

9.4.1.1 Impact Table – Soil erosion / degradation during construction

Nature: Soil degradation – Increased erosion due to construction activity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Very short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (40)**	**Low (18)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, moderate	Yes, minor

Can impacts be mitigated?	Yes

Mitigation:

- Restrict size of authorised disturbance areas.
- Minimise activity on steep slopes / the side of slopes.
- Implement effective erosion control measures.
- Stage construction in phases to minimise exposed ground.
- Keep to existing roads, where practical, to minimise impact on undisturbed ground.
- Ensure stable slopes of stockpiles/excavations to minimise slumping.
- Stockpiles should not exceed 2m in height unless otherwise permitted by the Engineer.
- Stockpiles not used in three (3) months after stripping must be seeded to prevent dust and erosion, only if natural seeding does not occur.

Cumulative impacts:

The cumulative impact of soil erosion from all development in the area is considered low if mitigating measures are adhered to.

Residual impacts:

Minor – Localised movement of sediment. Slow regeneration of soil processes

9.4.3 Soil Contamination / Soil Erosion during the Operation of the facility

During the maintenance activities (operations) of the site, the possibility for soil contamination exists in the event of spillage of oils, fuels or hydrocarbons used for maintenance of the wind turbines, substation or power line. In addition, spillage of fuels from vehicles may occur. These impacts on soil can be mitigated to a low significance.

9.4.3.1 Impact Table – Soil Contamination / Soil Erosion during the Operation of the facility

Nature: Increased pollution of soil by contaminants (e.g. fuel, oil, chemicals, cement).		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (2)	Very short term (1)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Low (12)**
Status	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Minor
Can impacts be mitigated?	Yes, to a certain extent	
Mitigation:	» Control use and disposal of potential contaminants or hazardous materials. » Remove contaminants and contaminated topsoil and replace topsoil in affected areas.	
Cumulative impacts:	» The cumulative impact of soil pollution is considered low due to the undeveloped nature of the study area.	
Residual impacts:	» Minor negative – slow regeneration of soil processes in and under topsoil	

9.4.4 Comparative Assessment of Grid Connection Options

The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation or power line routing alternatives in terms of impacts of soils or geology.

9.4.5. Cumulative impacts

The development of four or more projects in a clustered are have to potential to have negative impacts on soil, Soil erosion may arise due to altered surface water runoff. Adequate management and erosion control measures must be implemented. With good soil management, cumulative impacts can be prevented, provided that it is applied to all three development phases and other approved wind projects in the area.

9.4.7 Conclusions and Recommendations

» The proposed development of the Soetwater Wind Farm could have negative impacts on soils on the site. The wind energy facility on the site will not have a low impact on the impacts on land use, land capability and agricultural potential of the site (due to the low agricultural potential of the site).

» It is imperative though that adequate stormwater management measures be put in place as the soils on the site are highly prone to erosion due to shallow profiles and steep slopes. The main aspects that have to be managed on the site are:
  - o Construction activities, particularly excisions, and access roads. Erosion must be controlled through adequate mitigation and control structures on turbine sites as well as along access routes.
  - » Operational activities. Impacts from vehicles, such as spillages of oil and hydrocarbons, should be prevented and mitigated. Implement measures to avoid /reduce chemical spillages during the operation of the facility (such as spill kits).
  - o Dust generation on site should be mitigated and minimised as the dust is a social nuisance.

» The following mitigation measures are recommended:
  - » Minimise activity in erosion-sensitive areas
  - » Implement effective erosion control measures.
  - » Use existing roads, where practical, to minimise impact on undisturbed ground.
  - » Use slope stabilisation techniques to ensure stable slopes of stockpiles/excavations to minimise slumping.
  - » Site management has to be implemented with the appointment of a suitable environmental control officer (ECO) to oversee the process, address problems and recommend and implement corrective measures.
  - » Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads).
  - » Plan the road and site layout in such a way as to make maximal use of existing roads and fence/border areas to minimise impacts and to keep grazing and natural units as intact as possible.

9.5 Assessment of Potential Social Impacts

9.5.1 Construction - Creation of Employment and Business Opportunities and Opportunity for Skills Development

Construction can lead to direct and indirect social and economic positive impacts on a local and regional scale. The construction of one development phase (such as the Soetwater wind farm) is expected to extend over a period of 16-18 months and create approximately 300 construction-related jobs, which have been broken down as follows:

» ~25 % (75) will be available to skilled personnel (engineers, technicians, management and supervisory)
» ~ 15 % (45) to semi-skilled personnel (drivers, equipment operators), and
» ~ 60% (180) to low skilled personnel (construction labourers, security staff).

However, it should be noted that the majority of construction workers, specifically the members from the local community, who are employed during the construction of Phase 2 (Soetwater wind farm) are likely to be employed for Phase 1 and 3.

The total wage bill with the construction of the Soetwater wind farm (300 employees X 18 months) is estimated to be in the region of R 66 million. This is based on the assumption that the average monthly salary for low, semi and skilled workers is R 5 000, R 12 000 and R 30 000 respectively.

The work associated with the construction phase will be undertaken by contractors and will include the establishment of the access roads and services and the erection of the wind turbines, substations and power line. Members from the local community are likely to be in a position to qualify for the majority of the low skilled and some of the semi-skilled employment opportunities. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local community. Given the high unemployment levels and limited job opportunities in the area this will represent a positive social benefit. The remainder of the semi-skilled and majority of the skilled employment opportunities are likely to be associated with the skilled contactors.

9.5.1.1 Impact Table - Creation of Employment and Business Opportunities during the Construction Phase

***Nature*:** Creation of local employment and business opportunities during the construction phase associated with the wind energy facility.		
	Without Mitigation	**With Enhancement**
Extent	Local – Regional (2) (Rated as 2 due to potential opportunities for local communities and businesses)	Local – Regional (3) (Rated as 3 due to potential opportunities for local communities and businesses)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	***Medium (32)***	***Medium (36)***
Status	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	N/A	N/A
Can impact be enhanced?	Yes	
Mitigation: » Where feasible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi- and low-skilled job categories. » Before the construction phase commences the proponent should meet with representatives from the Local Municipality to establish what skills exist in the area and develop a database. » Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase. » The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. » The proponent, in consultation with the Local Municipality, should develop a database of local companies, specifically companies that qualify as Black Economic Empowerment (BEE) companies that qualify as potential service providers prior to the commencement of the tender process for construction contractors.		
Cumulative impacts: Opportunity to up-grade and improve skills levels in the area. However, due to relatively small number of local employment opportunities and limited skills range, this benefit is likely to be limited.		
Residual impacts: Improved pool of skills and experience in the local area. However, due to relatively small number of local employment and skills-transfer opportunities this benefit is likely to be limited.		

9.5.2 Presence of construction workers in the area

The area can be described as a rural area that is sparely populated. In terms of affected farmsteads, there are a relatively small number of farmsteads where people reside that will be directly affected by the proposed project. The findings of the SIA indicate that the farmers in the area are opposed to construction workers being accommodated on the site. The risk posed to farm workers is an issue of concern. There are approximately 19 labourer's that live on the farms affected by the proposed wind energy facility and ~ 15 more on the adjacent farms. These workers are rural, farming folk, Afrikaans speaking people with limited few urban/ life skills and would be vulnerable to impacts associated with the presence of construction workers. In this regard there was an increase in teenage pregnancies and incidence of STDs in Sutherland and the local rural area road when the road between Sutherland and the SALT facility was surfaced. Due to Laingsburg location on the N1, prostitution, STDs, alcohol and drug abuse are existing issues of concern. These issues could be exacerbated by the presence of construction workers.

The potential risk to local residents in the area could potentially be mitigated by implementing a local employment policy, specifically for the low and semi-skilled employment opportunities associated with the construction phase. To perhaps prevent these negative impacts, the towns of Sutherland, Laingsburg and Matjiesfontein are all located within an hour's drive of the site and can be used to accommodate workers. Employing members from the local community to fill the low-skilled job categories would reduce the risk and mitigate the potential impacts on the local communities. These workers will be from the local community and form part of the local family and social network and, as such, the potential impact will be low. However, due to the potential mismatch of skills and low education levels, the potential employment opportunities for the members from these local communities may be low.

ACED has indicated that construction workers will not be accommodated on site and will be transported to and from the site on a daily basis, from Sutherland; Laingsburg or Matjiesfontein. Exposure to farm workers and their families is therefore expected to be minimal. While the risks associated with construction workers at a community level will be low, at an individual and family level they may be significant, especially in the case of contracting a sexually transmitted disease or an unplanned pregnancy. However, given the nature of construction projects it is not possible to totally avoid these potential impacts at an individual or family level.

9.5.2.1 Impact Table – impact of the presence of construction workers in the area on local communities

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers		
	Without Mitigation	***With Mitigation***
Extent	Local (2)	Local (1)
Duration	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc. (5)	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc. (5)
Magnitude	Low for the community as a whole (4)	Low for community as a whole (4)
Probability	Probable (3)	Probable (3)
Significance	***Low for the community as a whole (21)***	***Low for the community as a whole (18)***
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods	
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be eliminated	

Mitigation:

» Where possible, the proponent should make it a requirement for contractors to implement a ‘locals first’ policy for construction jobs, specifically semi and low-skilled job categories. This will reduce the potential impact that this category of worker could have on local family and social networks;
» The proponent and the contractor should develop a Code of Conduct for the construction phase. The code should identify what types of behaviour and activities by construction workers are not permitted. Construction workers that breach the code of good conduct should be dismissed. All dismissals must comply with the South African labour legislation
» The proponent and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase;
» The movement of construction workers on and off the site, specifically construction workers from outside the area, should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting non-local workers to and from site on a daily basis;
» The contractor should make the necessary arrangements for allowing workers from outside the area to return home over weekends and or on a regular basis during the construction phase. This would reduce the risk posed by construction workers from outside the area on local family structures and social networks;
» It is recommended that no construction workers, with the exception of security

personnel, should be permitted to stay over-night on the site.
***Cumulative impacts*:** Impacts on family and community relations that may, in some cases, persist for a long period of time. Also in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.
Residual impacts: See cumulative impacts.

9.5.3 Construction - Risk of stock theft, poaching and damage to farm infrastructure

The presence of construction workers on the site increases the potential risk of stock theft and poaching, especially in an area that is sparsely populated and due to the fact that many landowners do not reside on the farms. The movement of construction workers on and off the site also poses a potential threat to farm infrastructure, such as fences and gates, which may also be damaged. Stock and game losses may also result from gates being left open and/or fences being damaged. In this regard, one of the landowners indicated that stock theft, specifically sheep, was a major concern. The landowner indicated that construction workers should not be housed on the site. The potential impacts associated with stock theft can, however, be effectively managed and mitigated, after which the impact significance is rated as low.

9.5.3.1 Impact Table – Stock theft and damage to farm infrastructure

Nature: Potential loss of livestock, poaching and damage to farm infrastructure associated with the presence of construction workers on site		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium **(33)**	Low **(24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock losses etc.	Yes, compensation paid for stock losses etc.
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	Yes
Mitigation: • The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase		

commences; • The proponent should consider developing a Code of Conduct for construction workers. The Code of Conduct should be signed by the proponent and the contractors before the contractors move onto site; • The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below); • The EMPr will outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested; • Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms. • Contractors appointed by the proponent must ensure that construction workers who are found guilty of stealing livestock, poaching and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation; • The housing of construction workers on the site should be limited to security personnel.
***Cumulative impacts*:** None**,** provided losses are compensated for.
Residual impacts: See cumulative impacts.

9.5.4 Increased risk of fires during construction

The presence of construction workers and construction-related activities on the site poses an increased risk of veld fires that in turn pose a threat to the natural fynbos vegetation, farmsteads, livestock and wildlife in the area. In the process, farm and tourism infrastructure may also be damaged or destroyed and human lives threatened. The issue of fire has been raised as a key concern by most farmers in the area, especially runaway fires in the summer months. The use of fire prevention and fire management strategies for the wind energy facility will reduce the risk of fires to a reasonable level.

9.5.4.1 Impact Table – Increased risk of fires

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires		
	Without Mitigation	***With Mitigation***
Extent	Local (4)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)

Significance	Medium **(36)**	Low **(24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock and crop losses etc.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Mitigation:

» The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences.
» Contractor to ensure that open fires on the site for cooking or heating are not allowed except in designated areas.
» Contractor to ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy summer months.
» Contractor to provide adequate fire fighting equipment on-site.
» Contractor to provide fire-fighting training to selected construction staff.
» As per the conditions of the Code of Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire fighting costs borne by farmers and local authorities.
» Use of fire prevention and fire management strategies for the wind energy facility.

Cumulative impacts:

None, provided losses are compensated for.

Residual impacts:

See cumulative impacts.

9.5.5 Impact due to increase in traffic during construction

Road access to the proposed wind energy facility site is likely to be from the N2 and the R345 to Sutherland. Thereafter, access to the site is likely to be via the Komsberg gravel road (P2243), off the tarred R354. Potential social impacts are linked to damage to road surfaces, specifically of the P2443 gravel road, and delays during the actual movement of construction traffic. The movement of heavy construction vehicles during the construction phase has the potential to damage roads and create noise, dust and safety impacts for other road users. The movement of large, heavy vehicles also has the potential to create delays for other road users, specifically local famers and community members.

Several abnormal loads using large trucks will be associated with the construction phase. In addition, crawler cranes (~ 750 t) and assembly cranes may also need to be transported onto and off the site. Other heavy equipment will include normal civil engineering construction equipment such as graders, excavators, cement trucks, etc. If required, ACED will consider the upgrade of the farm gravel roads to the site for the transportation of the wind turbine components during construction. ACED will have to apply for a permit to transport abnormal loads on public roads. In order to avoid traffic congestion and road safety during construction, various mitigation measures and road safety measures can be used.

9.5.5.1 Impact Table – Increase in traffic during construction

Nature: Traffic congestion and associated noise, dust and safety impacts associated with movement of construction related traffic to and from the site on road / private roads.		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	Low **(27)**	Low **(18)**
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Mitigation: » The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. This should include includes damage to local roads and internal farm roads. The agreement should be signed before the construction phase commences;		

» The proponent and contactor should meet with the local farmers to identify the best time of the day to transport heavy machinery on to the site so as to minimise potential disturbances to other road users; » The contractor must ensure that damage caused to roads by the construction related activities, including heavy vehicles, is repaired before the completion of the construction phase. The costs associated with the repair should be borne by the proponent; » Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers; » All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.
Cumulative impacts: If damage to roads is not repaired then this will impact on the farming activities in the area and also result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were not responsible for the damage.
Residual impacts: See cumulative impacts

9.5.6 Damage to and loss of farmland during construction

The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the wind turbines, substations and power lines may damage active farmland. During construction some areas may not be able to be accessed / grazed by the landowner due to construction activities. Furthermore, construction vehicles or personnel could damage farming areas outside of the construction footprint.

The landowner is compensated for leasing of the land by ACED. Where properly planned, the final footprint of disturbance associated with a wind energy facility is small and is linked to the foundation of the individual wind turbines, services roads, substations and power line. The impact on farmland associated with the construction phase can therefore be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase and that construction is limited to the area for the facility, so that farming activities may continue on areas that are not utilised by the wind energy facility. The impact can be reversed, as once construction is complete farming activities may resume on the site.

9.5.6.1 Impact Table – Damage to and loss of farmland during construction

Nature: The activities associated with the construction phase, such as establishment of

access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the wind turbines, sub stations and power lines will damage farmlands and result in a loss of farmlands for future farming activities.		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (1)
Duration	Long term-permanent if disturbed areas are not rehabilitated (5)	Short term if damaged areas are rehabilitated (1)
Magnitude	Moderate (4)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	High **(60)**	Low **(16)**
Status	Negative	Negative
Reversibility	Yes, disturbed areas can be rehabilitated	Yes, disturbed areas can be rehabilitated
Irreplaceable loss of resources?	No, disturbed areas can be rehabilitated and farming can resume on the properties once the wind energy facility construction is complete	No
Can impact be mitigated?	Yes, by compensation	Yes

Mitigation:

- The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. This should include damage to and loss of farm land. The agreement should be signed before the construction phase commences;
- The footprint associated with the construction related activities (access roads, turning circles, construction platforms, workshop etc.) should be minimised;
- All areas disturbed by construction related activities, such as access roads, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase;
- The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed to establish the project. The specifications for the rehabilitation programme should be drawn up the botanical specialist appointed as part of the EIA process;
- The implementation of the Rehabilitation Programme should be monitored by the ECO;
- ACED compensates farmers for leasing of the land for the wind energy facility, which is included in the rental agreement with the local landowners.

Cumulative impacts:

Overall loss of farmland could impact on the livelihoods of the affected farmers, their families and the workers on the farms and their families. However, disturbed areas can be rehabilitated.

Residual impacts**:** See cumulative impacts.

9.5.7 Operational Phase -Creation of Long- Term employment and business opportunities

Based on information from other wind project, the establishment of a 150MW will create approximately 50 permanent employment opportunities, broken down as follows:

- ~20% (10) will be available to skilled personnel
- ~80% (40) to semi and low skilled personnel.

The operational phase is expected to last 20 years. Members from the local community are likely to be in a position to qualify for the majority of the low skilled and some of the semi-skilled employment opportunities. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local community. Given the high unemployment levels and limited job opportunities in the area this will represent a significant social benefit. The remainder of the semi-skilled and majority of the skilled employment opportunities are likely to be associated with people from outside the area.

Given the location of the proposed wind energy facility, the majority of permanent staff is likely to reside the local towns in the area, such as Laingsburg, Sutherland and Matjiesfontein. In terms of accommodation options, a percentage of the new permanent employees may purchase houses in one of these towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the annual wage bill earned by permanent staff would be spent in the regional and local economy. This will benefit local businesses in the local towns in the area. The benefits to the local economy will extend over the 2o-year operational lifespan of the project. The local hospitality industry is also likely to benefit from the operational phase. These benefits are associated with site visits by company staff members and other professionals (engineers, technicians etc.) who are involved in the company and the project but who are not linked to the day-to-day operations. The establishment of a Community Trust, as required in terms of the Request for Proposal Document prepared by the Department of Energy, will also create potential benefits for the local community.

9.5.7.1 Impact Table – Creation of Long- Term employment and business opportunities

Nature: Creation of long-term employment and business opportunities associated with the operational phase

	Without Mitigation	With Enhancement
Extent	Local (1)	Local and Regional (4) (Assumes establishment of a Community Trust as indicated below)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)
Significance	Low **(27)**	Moderate **(56)**
Status	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources?	No	
Can impact be enhanced?	Yes	

Enhancement:

- ACED to investigate the opportunities for establishing a Community Trust. The revenue for the trust would be derived from the income generated from the sale of energy from the wind energy facility and used to support local IDP projects and initiatives.
- The establishment of a Community Trust should be discussed with the Local Municipality.
- The proponent should implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's and locals employed during the operational phase of the project.

Cumulative impacts:

Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities in the area. Creation of revenue stream to fund local projects, thereby enhancing local economic and social development in the area.

Residual impacts:

See cumulative impacts

9.5.8 Development of Renewable Energy Infrastructure

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions (Cape Times, 15 November 2007).

The establishment of a clean, renewable energy facility will therefore reduce, albeit minimally, South Africa's reliance on coal-generated energy and the generation of carbon emissions into the atmosphere. The overall contribution to South Africa's total energy requirements of the proposed wind energy facility is relatively small. However, the ~ 150 MW installed capacity will contribute towards offsetting the total carbon emissions associated with energy generation in South Africa. Given South Africa's reliance on Eskom as a power utility, the benefits associated with an IPP based on renewable energy are regarded as significant.

The promotion of renewable energy sources is supported at national and provincial levels. As indicated above the fit with national and provincial energy policies should be viewed within the context of the site's location the potential impact on the areas sense of place and surrounding tourist related land uses. In addition, the current application is not unique. In this regard, a significant number of wind developments are currently proposed in the Northern Cape and other parts of South Africa. The potential contribution of this project should therefore be regarded as valuable, but should not be overestimated / exaggerated.

9.5.8.1 Impact Table – Contribution of the project towards Development of Renewable Energy Infrastructure in South Africa

Nature: Development of infrastructure to generate clean, renewable energy		
	Without Mitigation	**With Mitigation**
Extent	Local, Regional and National (4)	Local, Regional and National (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (56)**	**Medium (56)**
Status	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of resources?	Yes, impact of climate change on ecosystems	

Can impact be mitigated?	Yes	

Enhancement:

- Use the project to promote and increase the contribution of renewable energy to the national energy supply;
- Implement a skills development and training programme aimed at maximising the number of employment opportunities for local community members;
- Investigate the opportunities for establishing a Community Trust that would benefit local, disadvantaged and vulnerable communities.

Cumulative impacts: Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.

Residual impacts: See cumulative impacts

9.5.9 Potential Impact of the wind energy facility on tourism in the region

Tourism in the study area can be described as modest, and is largely associated with the town of Sutherland and the small Victorian rail siding of Matjiesfontein. With regards to Sutherland, the commissioning of the South African largest Telescope (SALT) resulted in a boom in the local tourism sector, specifically in the town of Sutherland. The town currently receives an estimated 15 000 visitors annually. The modest tourism boom has had direct positive knock-on effects on local employment creation and the growth of the local retail sector.

The proposed Soetwater site is located ~ 60 km to the south of the SAAO/SALT site and night-time light emissions from warning lights on the turbines may compromise the areas integrity with regard to observations from SALT, depending on the CAA requirements in this regard. This may be exacerbated by other wind projects that may be developed in the area, including the approved Moyeng Suurplaat wind project (400 turbines located ~30km east-north east of site) and proposed G7 Roggeveld wind project (250 turbines located to west of site). Negative impacts on SALT may impact on the day-to-day operations of the observatory and also impact negatively on local tourism industry. However, approval of the Hidden Valley wind project will be contingent on ACED’s ability to prove that the facility will not contravene the provisions of the Astronomy Geographic Advantage (AGA) Act (2007).

Other existing tourism initiatives around Sutherland are largely concentrated to the north (towards Calvinia) and west (Ceres) of the town. The area towards the south-east of Sutherland – i.e. the Hidden Valley area – is essentially undeveloped, and does not form part of any of the current tourism development initiatives. However, the activities on the Komsberg Wilderness Nature Reserve (KWNR), located in the Komsberge ~ 5-7 km north of the wind energy facility site, may be negatively impacted. The KWNR is ~12 000 ha in extent, and consists mainly of rehabilitated veld. A number of large mammal species have been reintroduced, including mountain zebra, red hartebeest, gemsbok, and brindled and black wildebeest. A number of scenic lookout points along the Great Escarpment are located in the KWNR. The KWNR currently uses the property primarily for the sake of non-profit conservation (i.e. no public game viewing, hunting, tourism accommodation, etc.). The KWNR offers working holidays on the property, mainly to paying British volunteers who typically come out for periods of 10 days or so. Volunteers stay in the Komsberg farmstead, located on the property (~7 km from nearest proposed turbine location). The experience of the visitors to the KWNR may be negatively impacted by the presence of wind turbines.

In addition, given that there are a number of other wind project proposed in the area the potential benefits to tourism associated with the novelty and scale of the project should not be overstated, and need to be carefully balanced against potential losses of open spaces and scenic vistas. The potential impact on future wilderness-based tourism options also need to be taken into account by the authorities. As indicated above, the impact on the sense of place and the landscape character of the area may be a concern. Findings from studies undertaken in Scotland indicate that there appears to be no clear evidence that tourists would be put off by the presence of wind farms. In this regard far more visitors appeared to associate wind farms with clean energy than with landscape damage, suggesting that they could help to promote Scotland's reputation as an environmentally friendly country as long as they are sensitively sited. This argument could also apply to the South African context. However, the research does note that this could change as more wind projects are built. This applies to the study area and other parts of South Africa.

The impact on tourism is linked to the visual impact on the areas sense of place and landscape character. The findings of the VIA (MetroGIS, March 2012) indicate that the while the area surrounding the site is itself not a major tourist attraction, the R354 is a primary tourism route for visitors to the town of Sutherland and its attractions. The visual impact on the R354 is expected to be of low to moderate negative significance. No mitigation is possible. The findings for the VIA for the Soetwater wind farm is that the visual impact will be of a medium significance.

The findings of the Visual Impact Assessment (VIA) (MetroGIS, March 2012) also indicate that the potential for mitigating the impact on the area's sense of place and the landscape is low. In this regard, the Australian National Wind Farm Development Guidelines stress the importance of general location and site selection.

Research in Scotland undertaken by Warren and Birnie (2009) found that there appeared to be no clear evidence that tourists would be put off by the presence of wind farms in tourism areas. In this regard, the research found that far more visitors appeared to associate wind farms with clean energy than with landscape damage, suggesting that they could help to promote an area's reputation as an environmentally friendly area, provided they are sensitively sited. However, the paper notes that this could change as more are built. The key lesson for South Africa is this regard is that wind farms should be located in areas that minimise the potential impact on landscapes and as such also reduce the potential impact on tourism.

9.5.10.1 Impact on tourism industry

Nature: Potential negative impact of the wind energy facility on local tourism		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium **(33)**	Medium **(33)**
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impact be mitigated?	No	
Mitigation: In terms of mitigating the visual impacts, it is virtually impossible to hide the facility. The impact on the sense of place of the area cannot therefore be effectively mitigated.		
Cumulative impacts: Potential for fewer tourists to visit the area, and impact on tourist sector (Negative) – however unproven in South Africa		
Residual impacts: See cumulative impacts		

9.5.10 Potential Health Impacts due to the Operation of the wind energy facility

The potential health impacts typically associated wind energy facilities include, noise (discussed as a separate impact in this report), shadow flicker and electromagnetic radiation. The findings of a literature review undertaken by the Australian Health and Medical Research Council published in July 2010 indicate that there is no evidence of wind farms posing a threat to human health. The research also found that wind energy is associated with fewer health effects than other forms of traditional energy generation (WHO, 2004).

Based on these findings it is assumed that the significance of the potential health risks posed by the proposed Soetwater Wind Farm is of low significance. The potential noise impacts are covered in the specialist Noise Impact Assessment.

9.5.11 Comparative Assessment of Grid Connection Options

There will be no differences in the significance of social impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a social perspective. No specific preference for substation alternatives made, as the location of the substation does not directly have any social impacts on any people who reside in or around the site (which is a sparsely populated region).

9.5.12. Cumulative Social Impacts

Based on the information available at the time of undertaking this EIA, four wind energy facilities have an environmental authorisation and occur in close proximity to the Hidden Valley site.

Cumulative social impacts include the Soetwater wind farm, and the other two development phases, as well as the three other wind projects that are approved in the area include:

- Positive impact from job creation and indirect socio-economic spin-offs.
- Potential cumulative negative visual impacts from several wind projects in the region.

c) <u>Job Creation</u>

Logically, having more than one wind project in this region will have cumulative positive social impact due to job creation during construction and operations. This impact is attempted to be quantified here. It should be noted that the majority of construction workers, specifically the members from the local community, who are employed during the construction of Phase 2 (Soetwater Wind Farm) are likely to be employed for Phase 1 and 3. Phase 1 and 3 will therefore not employ an additional 600 workers. For the purposes of the SIA it is assumed that 80% of the workers employed in Phase 2 will be employed during Phase 1 and 3. The total number of construction related employment opportunities associated with all three Phases 1, 2 and 3 will therefore be ~ 420. The total additive wage bill for Phase 1, 2 and 3 will therefore be ~ R 198 million. For the purposes of the SIA it is assumed that the operation of a 450MW site can be undertaken by 100 permanent workers.

d) <u>Visual Impacts</u>

It is obvious, that the overall visual impacts associated with a 450MW wind energy facility will be greater than the visual impacts associated with a 150MW facility. Furthermore having several projects in a region will also have a greater visual impact. Refer to Section 9.5 for more information on visual impacts.

The Australian Wind Farm Development Guidelines (Draft, July 2010) indicate that the cumulative impact of multiple wind farm facilities is likely to become an increasingly important issue for wind farm developments in Australia. This could occur in South Africa. In terms of assessing cumulative impacts, the Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts of wind farms on landscapes, including:

- Combined visibility (whether two or more wind farms will be visible from one location).
- Sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail).
- The visual compatibility of different wind farms in the same vicinity.
- Perceived or actual change in land use across a character type or region.
- Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010).

The potential cumulative impacts are largely linked to the visual impact of the turbines and power lines on the areas sense of place and landscape character. It is obvious, that the overall visual impacts, and hence cumulative impacts, associated with all three development phases (i.e. 450MW project) will be greater than the cumulative impacts associated with a 150MW facility. The cumulative impacts associated with the proposed Hidden Valley project (regardless of size) are exacerbated by the sites location in relation to the approved Moyeng Suurplaat wind project (400 x turbines, 1200 MW), the G7 Roggeveld wind project (250 x turbines, 750 MW) and the approved Konstabel wind project. The potential for cumulative impacts is therefore potentially high. None of the projects in this area have, however, been awarded preferred bidder status at this time.

The issue of Sequential Visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail) is therefore a concern. The potential cumulative impacts are also highlighted by the findings of the VIA (refer to Section 7.5).

In summary, the proposed establishment of three or possibly other wind energy facilities in the area will impact negatively on the landscape and the areas rural sense of place and character.

9.5.14 Conclusions and Recommendations

There will be net positive and negative social impacts from the development of the Soetwater Wind Farm. The following is the pertinent recommendations of the SIA, to be included in the EMPr and to be considered by the decision-making authority:

» The establishment of a community trust funded by revenue generated from the sale of energy the project.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» Use of fire prevention and fire management strategies for the wind energy facility, to reduce risks to landowners.
» Negative cumulative social (visual) impacts are a concern due to the number of proposed wind projects in this region of the Northern Cape. The establishment of a number of large wind projects in the area will have a significant impact on the landscape and the areas rural sense of place and character.

The proposed development represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. The cumulative impacts associated with the establishment of a number of proposed wind energy facilities in the area on the local sense of place and landscape cannot be ignored. Likewise the potential employment and community trust related benefits will also increase with the increase in the size of the proposed project.

9.6 Assessment of Potential Visual Impacts

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General. The approach utilised to identify issues related to the visual impact included the following activities:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment;
- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.;
- The identification of sensitive environments upon which the proposed facility could have a potential impact;
- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

The visual character of the sites consists of bands of mountainous terrain, below the escarpment. The site is remote, is an area with small numbers of permanent dwellers. Many of the adjacent landowners do not reside on their farms. This visual character has to a large extent determined the significance of the visual impact on the wind energy facility.

9.6.1 Visual Exposure of Phase 1 – Soetwater wind farm

The result of the combined viewshed analyses for the proposed wind energy facility's layout is shown on **Figure 9.8.** The viewshed analysis not only indicates areas from where the wind turbines would be visible (any number of turbines with a minimum of one turbine), but also indicates the potential frequency of visibility (i.e. how many turbines are exposed).

The dark orange areas indicate a high frequency (i.e. 51-56 turbines or parts thereof may be visible) while the yellow areas represent a low frequency (i.e. 1-6 turbines or parts thereof may be visible).

Potential visual exposure as a result of the proposed Soetwater project extends primarily to the west of the study area, extending in excess of 20km up the Tankwa River valley. Elevated East facing slopes are also exposed. Several residences and homesteads occur along these east facing slopes and Tankwa River valley. Moderate exposure is expected in these areas.

Visual exposure to the north is low to moderate within a 5km radius north of the site due to the topography falling away. Visual exposure increases to moderate between 10-15km north of the site in areas with a southerly aspect. Several settlements are present on these south facing slopes.

The far north of the study area, beyond 15km, is visually screened by the mountain range.

In the south, the extent of potential visual exposure is limited to north facing slopes by east-west orientated ridgelines. The elevation decreases to the south of the site resulting in low to moderate potential visual exposure being limited to the crests of north facing ridges between 10 and 20km to the south. There are very few settlements to the south of the site with the majority of these not expected to be visually impacted.

The highest frequency of potential visual exposure is centred on the site itself. The site lies on an elevated plateau. The settlements of Bobbejaanfontein and Oranjefontein fall on this plateau and up to 56 turbines may be visible from these areas, due to the elevated location of the proposed turbines.

Visual exposure to the east within a 5km radius is low to moderate as a result of the decrease in elevation to the east. Beyond 5km visual exposure is low to moderate and limited to elevated west facing slopes. Several settlements occur to the east, however the majority of these are along the valley floors and will be unaffected.

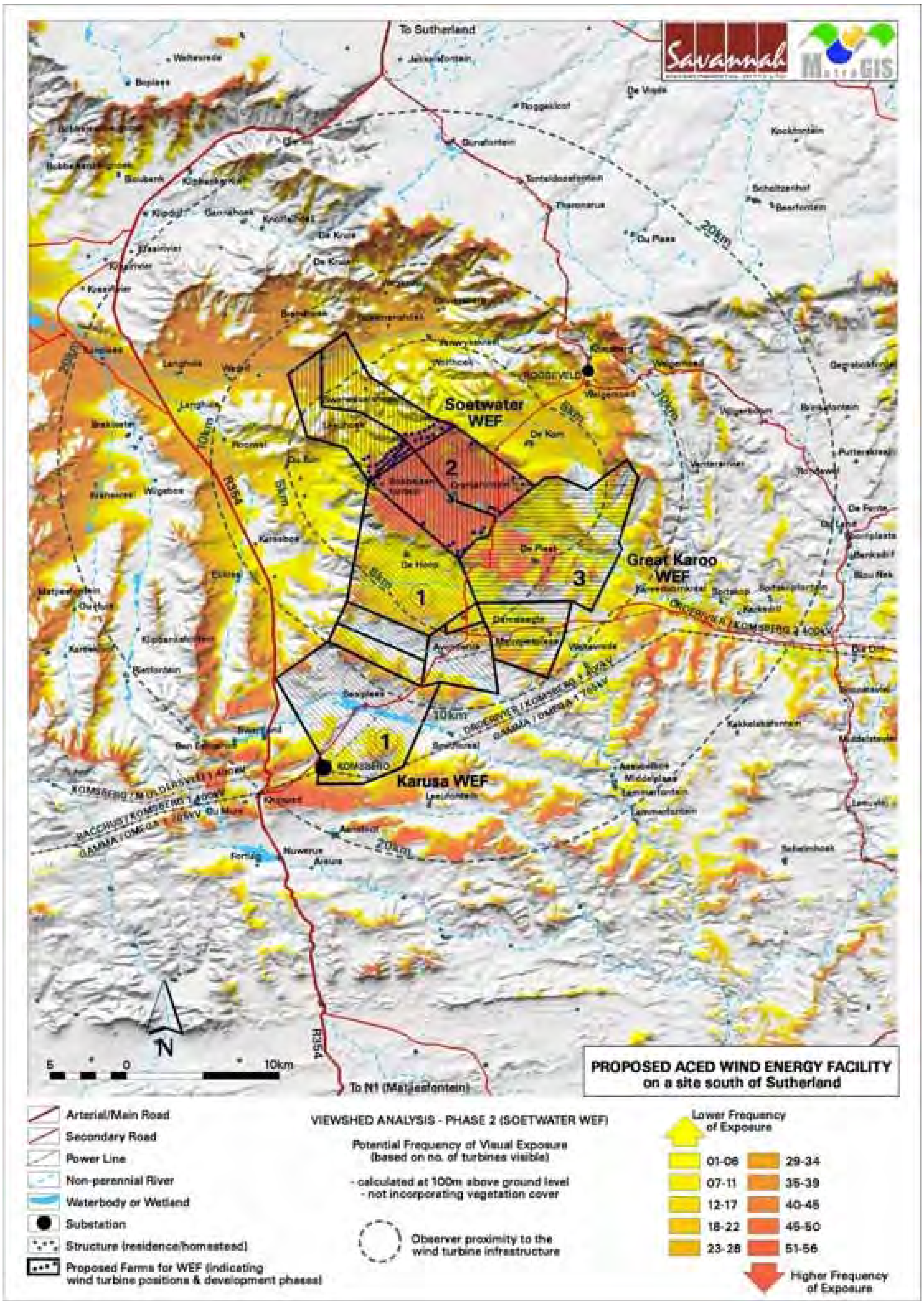

Figure 9.8: Viewshed Analysis of the proposed Soetwater Wind Farm

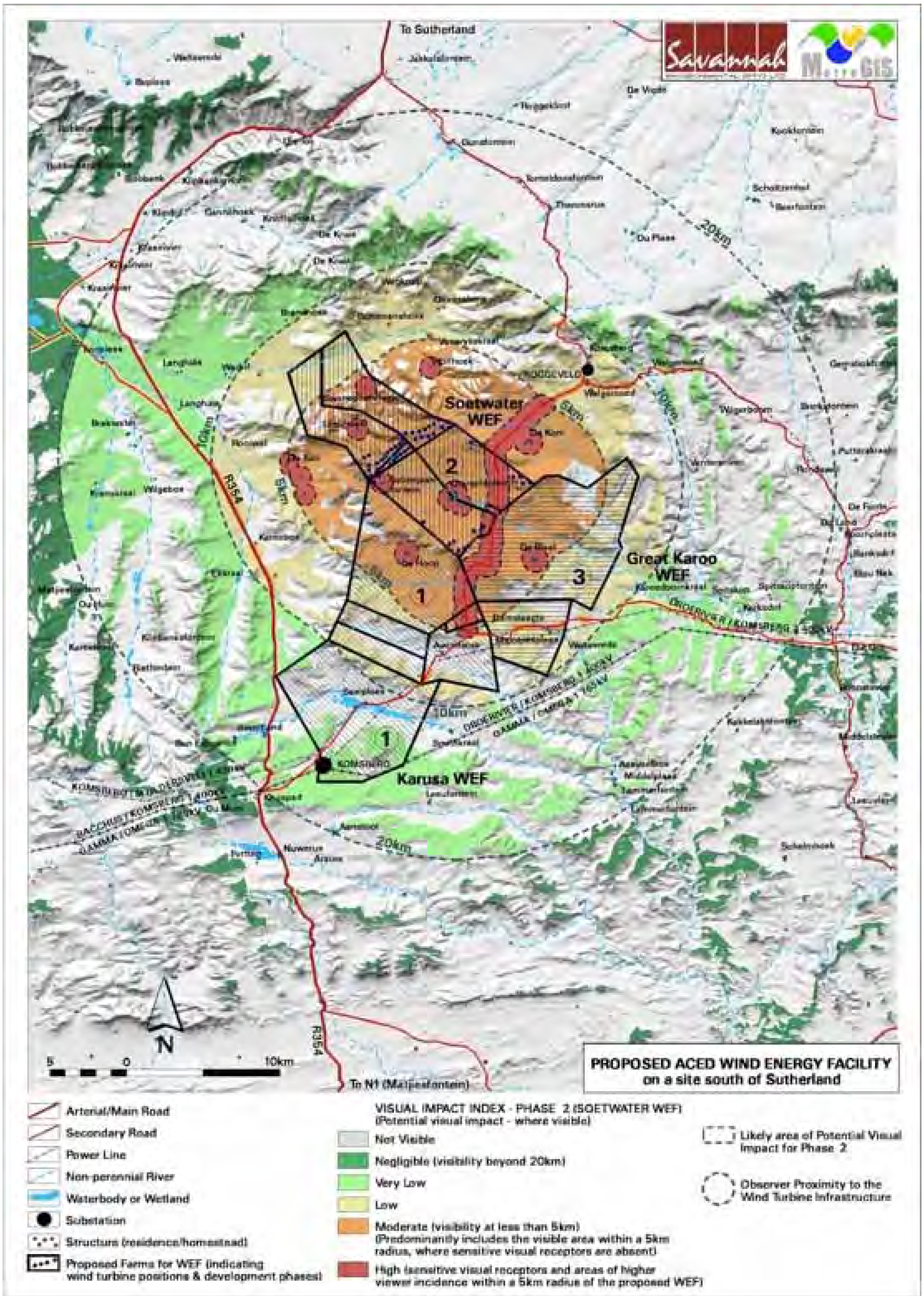

Figure 9.9: Visual impact index of Phase 2 (Soetwater Wind Farm) of the proposed Hidden Valley wind energy facility.

The topography and the placement of the wind turbines on the high ground influence the frequency of exposure. The following is of relevance:

» There exists a core area of potentially **moderate** visual impact on the site itself and within a 5km radius of the proposed project. There are several visually screened patches towards the periphery of this zone.
» Potential areas of **high** visual impact within this 5km radius include a stretch the secondary road between the Komsberg substation and the Roggeveld substation. Several settlements and homesteads also fall within this 5km radius. These receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 56 turbines). Specific homesteads and settlements include the following:
  o Ou Tuin;
  o Leeuhoek;
  o Swanepoelshoek;
  o Wolfhoek;
  o De Kom;
  o De Plaat
  o Bobbejaansfontein;
  o Oranjefontein;
  o De Hoop.
» The extent of potential visual impact is **Low** between the 5km and 10km radius, while the hilly topography results in large visually screened patches. Areas of potentially **moderate** visual impact are restricted to roads and only a few settlements.
» A stretch of the R354 in the west, as well as discontinuous stretches of secondary roads to the south and east of the site, will be exposed to potentially **moderate** visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 56 turbines). Homesteads and settlements include the following:
  o Meintjiesplaas;
  o Damslaagte;
  o Kareebos;
  o Rooiwal;
  o Boesmanshoek;
  o Wegkruip;
  o Oliviersberg;
  o Vanwykskraal;
  o Welgemoed.

» Beyond the 10km radius (but within the 20km radius), the extent of potential visual impact decreases quite markedly, with visually exposed areas located mainly in the north west, south and east. The magnitude of visual impact in the visually exposed areas is reduced to **very low**.

» Large areas in the north and east of this zone are visually screened by the elevated plateau and undulating topography.
» Sensitive visual receptors likely to be exposed to high frequencies of visual exposure include a section of the R354 and secondary road to the north west and south west of the site, and limited discontinuous stretches of secondary roads to the east and north east. These receptors are likely to experience **low** visual impact. A number of settlements and homesteads are likely to experience a similar impact. These are located primarily in the north west of the zone. Affected homesteads and settlements include the following:
  - Kranskraal;
  - Langhuis;
  - TuinPlaas;
  - Wadrif;
  - Brandhoek.
» In the longer distance (i.e. beyond the 20km radius), visual exposure is further reduced in both extent and magnitude. Visual impacts are likely to be **negligible**.
» Visual receptors include the area to the north west along the Tankwa river Valley and elevated ridges to the west, east and south east.

9.6.1.1 Photo Simulations

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the wind energy within the receiving environment. Refer to Visual Assessment (Appendix I) for the remainder of the photo-simulations. Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the proposed wind energy facility within the receiving environment. The purpose of the photo simulation exercise is to support the findings of the VIA, and is not an exercise to illustrate what the facility will look like from all directions.

The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility. The simulations are based on the wind turbine dimensions and layout as indicated on **Figure 9.10 and Figure 9.11.**

Each photographic simulation is preceded by a panoramic overview of the landscape from the specified viewpoint being discussed. The panoramic overview allows for a more realistic viewer scale that would be representative of the distance over which the turbines are viewed. Where relevant, each panoramic overview indicates the section that was enlarged to show a more detailed view of the wind energy facility.

The simulated wind turbines, as shown on the photographs, were adapted to the atmospheric conditions present when the original photographs were taken. This implies that factors such as haze and solar glare were also simulated in order to realistically represent the observer's potential view of the facility.

Figure 9.10: Photo simulation of the possible view of the wind turbines from the R354 road
*Viewpoint 2 is located on the arterial R354 to the west of the proposed wind energy facility, a short distance north of viewpoint 2. The point is located approximately 10km away from the closest turbine of the Soetwater wind energy facility. The viewing direction is south easterly and is representative of a medium distance view that residents of local homesteads and visitors to the area will experience while travelling this road between Sutherland and Matjiesfontein. Approximately **71** turbines are fully or partially visible in the landscape.*

Figure 9.11.: Photo simulation of the possible view of the wind turbines from the secondary road that traverses the site

*Viewpoint 3 is located on the secondary road which traverses the proposed Hidden Valley wind energy facility, running from the R354 in the south west to the Roggeveld Substation to the north east of the site. The point is located on the boundary of the proposed Soetwater Wind Farm site approximately less than 1km away from the closest turbine. The viewing direction is south westerly and is representative of a short distance view that residents of local homesteads and visitors to the area will experience while travelling along this secondary road. Approximately **95** turbines are fully or partially visible in the landscape*.

9.6.1.2 Impact Table - visual impact on residents of settlements and homesteads within 5 km from the site

Nature: Potential visual impact on residents of settlements and homesteads in close within 5 km from the site		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/A
Duration	Long term **(4)**	N/A
Magnitude	Low (4)	N/A
Probability	Highly Probable (4)	N/A
Significance	**Medium (48)**	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Recoverable **(3)**	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	No	N/A
Mitigation: None.		
Cumulative impacts: The construction of up to 75 wind turbines will increase the cumulative visual impact within the region.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

9.6.2 Change of visual character and sense of place of the region

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.) play a significant role. A visual impact on the "sense of place" is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

Specific aspects contributing to the sense of place of this region include the pastoral visual quality of the farmland and the scenic beauty of the coastline and of the mountains inland. The anticipated visual impact of the facility on the regional visual character, and by implication, on the sense of place, is expected to be moderate. There is no mitigation for this impact.

9.6.2.1 Impact Table - visual character and sense of place

Nature of Impact: Potential visual impact on the visual character and sense of place of the region.		
	No mitigation	***Mitigation Considered***
Extent	Regional **(3)**	N/A
Duration	Long term **(4)**	N/A
Magnitude	Moderate **(6)**	N/A
Probability	Probable **(3)**	N/A
Significance	Moderate **(39)**	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Recoverable **(3)**	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	No	N/A
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of up to 75 wind turbines will increase the cumulative visual impact within the region.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

9.6.3. Lighting Impacts

The area immediately surrounding the proposed facility has a relatively low incidence of receptors and light sources, so light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The wind energy facility may contribute to the effect of sky glow in an otherwise dark environment. Lighting impacts will be moderate significance both before and after mitigation.

The SALT is situated at the South African Astronomical Observatory (SAAO) field station 14km east of the town of Sutherland. This site, in the arid Karoo region, was established in the early 1970's and was chosen for its dark and clear skies and good weather conditions. The site is 35km to the north east of the proposed wind energy facility and lies on an elevated plateau. The SALT lies on the plateau at an elevation of 1755m ASL. The highest turbine elevations are expected to be at approximately 1500m ASL (height of hub of most elevated turbines).

While light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity, it is not possible to see these lights from the SALT due to elevated topography which limits visibility to 10km to the north east.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low. The furthest extent of direct visibility of turbine hubs and lights in the direction (NE) of the SALT is 10km.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow. This impact is the only light impact with the potential to affect the SALT.

The intensity of light generated by the wind energy facility is expected to be of a lower order than that generated by the urban area of Sutherland due to the dispersed nature of the turbines. The distance of the SALT from the wind energy facility and the elevated position of the SALT reduce the significance of this impact to insignificant.

9.6.3.1 Impact Table - Significance of visual impact of lighting at night on visual receptors in close proximity to the proposed wind energy facility

Nature of Impact: Potential visual impact on of lighting at night on visual receptors in close proximity to the proposed wind energy facility.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Low **(4)**
Probability	Probable **(3)**	Probable **(3)**
Significance	Moderate **(42)**	Moderate **(36)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	N/a
Mitigation: Planning: mounting aircraft warning on the turbines representing the outer perimeter of the facility. Planning: pro-active lighting design and planning. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of 77 wind turbines with their aircraft warning lights will increase the cumulative visual impact of such warning lights within the region. This is specifically relevant in context of the two projects near the Soetwater Wind Farm which have been authorised by DEA.		
Residual impacts: None. The visual impact of lighting will be removed after decommissioning and the removal of the wind turbines.		

9.6.4. Shadow flicker

Shadow flicker occurs when the sky is clear, and when the rotor blades are between the sun and the receptor (i.e. when the sun is low). De Gryse in Scenic Landscape Architecture (2006) found that “most shadow impact is associated with 3-4 times the height of the object”. Based on this research, a 500m buffer along the edge of the facility is submitted as the zone within which there is a risk of shadow flicker occurring. In this respect, inhabited settlements and homesteads within the site, as well as those within 500m of the property boundary may experience a visual impact of low significance both before and after mitigation.

Shadow flicker only becomes an issue if a wind turbine is in close proximity to houses / dwelling. To avoid shadow flicker, ACED to put in a turbine separation distances to avoid shadow flicker. Taking into account site constraints ACED should use a minimum spacing of 5 rotor diameters (approximately 560m) based on our maximum turbine envelope in the prevailing (bi-directional east west) wind directions, 3 rotor diameters (approximately 336m) for non-predominant.

9.6.6.1 Impact Table - Significance of visual impact of shadow flicker

Nature of Impact: Potential visual impact of shadow flicker on visual receptors in close proximity to the proposed wind energy facility.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(1)**
Significance	Low **(24)**	Low **(12)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	N/a
Mitigation: Planning: ensure that all wind turbines are 500m or further from the nearest inhabited homestead of settlement. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: None.		
Residual impacts: None. The visual impact of shadow flicker will be removed after decommissioning and the removal of the wind turbines.		

9.6.5. The potential to mitigate visual impacts

It is not possible to mitigate the primary visual impact, namely the appearance of the wind energy facility (the wind turbines). The functional design of the turbines (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*". Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact. The overall potential for mitigation is generally low or non-existent.

Mitigation of visual impacts associated with the construction of roads includes the use of existing roads wherever possible.

Where new roads are required, these should be planned taking due cognisance of the topography. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems. Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning. It is recommended that the substation design makes use of low profile construction technology to mitigate visual impact on the surrounding area.

The Civil Aviation Authority (CAA) prescribes that aircraft warning lights be mounted on the turbines. However, it is possible to mount these lights on the turbines representing the outer perimeter of the facility. In this manner, fewer warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact. The regulations for the CAA's *Marking of Obstacles* should be strictly adhered to, as the failure of complying with these guidelines may result in the developer being required to fit additional light fixtures at closer intervals thereby aggravating the visual impact.

Mitigation of other lighting impacts includes the pro-active design, planning and specification lighting for the facility by a lighting engineer. The correct specification and placement of lighting and light fixtures for the turbines and the ancillary infrastructure will go far to contain rather than spread the light. Additional measures include the following:

» Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
» Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights;
» Making use of minimum lumen or wattage in fixtures;
» Making use of down-lighters, or shielded fixtures;
» Making use of Low Pressure Sodium lighting or other types of low impact lighting.
» Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

Mitigation of potential shadow flicker impacts includes ensuring that all wind turbines are located 500m or further from the nearest inhabited homestead of settlement. Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of the construction site. Construction should be managed according to the following principles:

- » Reduce the construction period through careful planning and productive implementation of resources.
- » Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing.
- » Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
- » Ensure that rubble, litter and disused construction materials are managed and removed regularly.
- » Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way
- » Reduce and control construction dust through the use of approved dust suppression techniques.
- » Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
- » Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.
- » Secondary impacts anticipated as a result of the proposed wind energy facility (i.e. visual character and sense of place) are not possible to mitigate.
- » There is no mitigation to ameliorate the negative visual impacts on tourist routes, destinations and potential of the region.
- » Once the wind energy facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated.

The possible mitigation of both primary and secondary visual impacts as listed above should be implemented and maintained on an on-going basis.

9.6.6. Cumulative impacts

Figure 9.12 shows the potential cumulative visual exposure of the three development phases (Phase 1, Phase 2 (Soetwater) and Phase 3). The cumulative visual impact is highest within a 5km radius of the turbine infrastructure. This impact moderates with distance. Slopes that have aspects that face the wind energy facility experience very high visual impact. There are several visually screened patches towards the eastern periphery of this zone. 15 settlements that will experience visual impact fall within this zone. Eleven of these settlements potentially experience a very high visual impact. These are further categorised in terms of intensity of visual impacts.

Potential areas of high intensity visual impact (3 phases visible) within this 5km radius include a stretch the secondary road running north-south through the centre of the wind energy facility and two settlements located centrally within the wind energy facility, namely:

» De Hoop;
» Oranjefontein.

Areas of high intensity visual impact (3 phase visible) are restricted to within the footprint of the wind energy facility.

Potential areas of moderate intensity visual impact (2 phases visible) within this 5km radius include a stretch the secondary road running north from the northern periphery of the wind energy facility towards the Roggeveld substation and a short stretch of secondary road west of Meintjiesplaas. Five settlements are identified as having a moderate intensity visual impact within this zone, namely:

» Meintjiesplaas;
» De Plaat;
» Bobbejaanfontein;
» De Kom;
» Ou Tuin.

A stretch of the R354 in the west, as well as discontinuous stretches of secondary roads to the south and east of the site, will be exposed to potentially moderate visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to higher frequencies of visual exposure.

Based on the information available at the time of undertaking this EIA, four wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site.

Cumulative visual impacts include the Soetwater Wind Farm, and the other two development phases, as well as the four or more other wind projects that are approved in the area include. This would imply an incremental increased in visual impact in this region of the Karoo. On the other hand, from a visual perspective, the overlapping viewshed may be favourable, as it represents the consolidation and concentration of potential visual impacts within a clustered zone of 15-20 km.

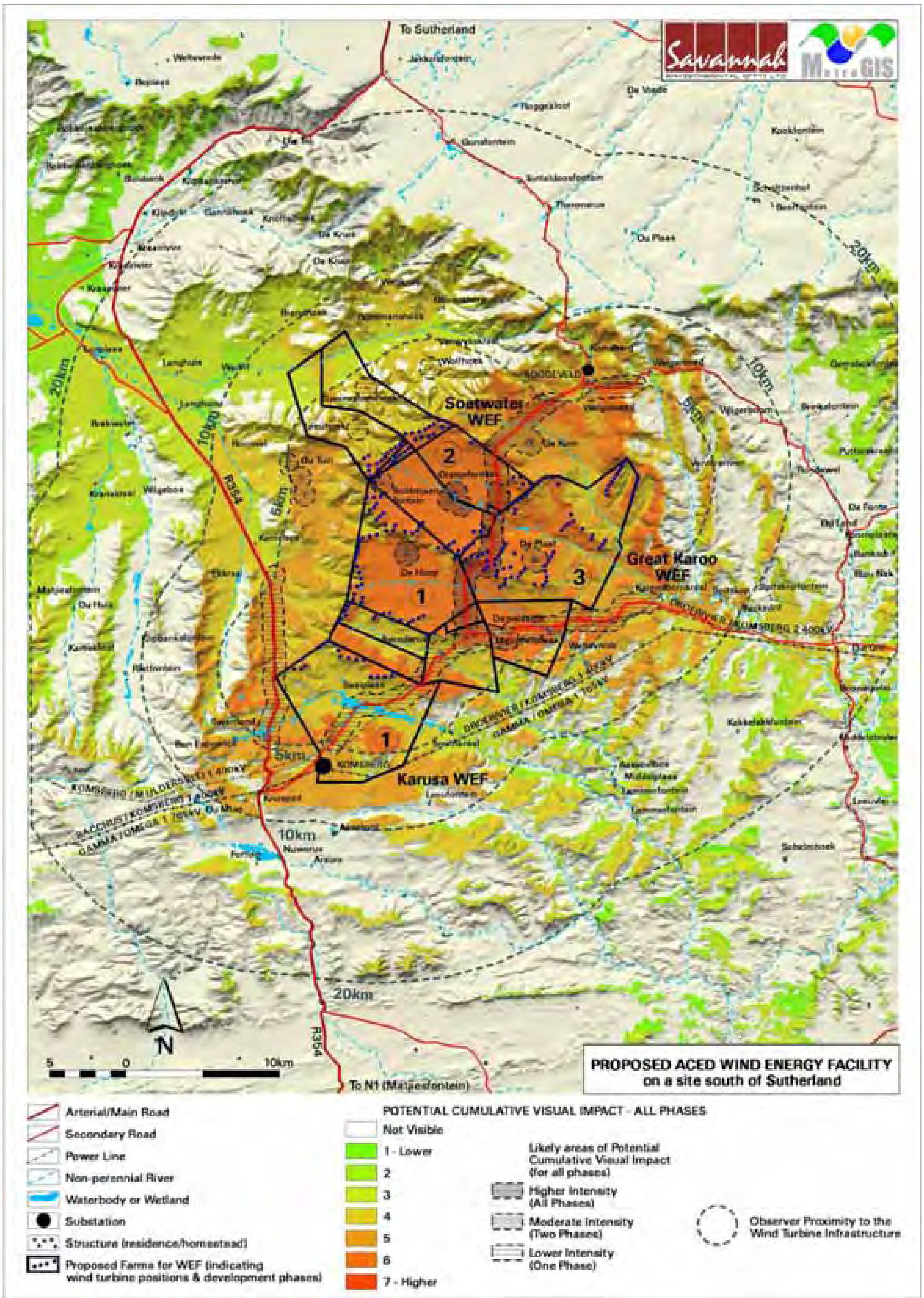

Figure 9.12: Cumulative Visibility analyses (for the three development Phases of the Hidden Valley project).

9.6.7. Comparative Assessment of Substation Options

There will be no differences in the significance of visual impacts for any of the alternative substation or power line routings. This is because the region in which the site is located is sparsely populated, with large distances between one homestead and the next. Furthermore, the visual landscape is already disturbed with the current 400 kV substation and power line that is located on the site as well as power lines, which the substation will be located next to. Therefore both proposed alternatives are considered acceptable from a visual impact perspective.

9.6.8 Conclusions and Recommendations

The construction and operation of the proposed Soetwater Wind Energy Facility and its associated infrastructure will have a visual impact on the visual environment especially within, but not limited to the area within 10km of the proposed facility. Beyond this visual impact is reduced by the screening effects of the rugged topography and the contained nature of the site. The exception to this is a corridor of visual intrusion up the Tankwa River valley, however there are very few visual receptors in this area. Visual impact in this area is also greatly reduced by distance from the site.

The low density of visual receptors results in a low intensity of visual impact, however the significance of the impacts is moderate to high as a result of undeveloped character of the landscape.

The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants.

However, these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements and tourists passing through or holidaying in the region.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development. The character of the site will be altered by the presence of the wind energy facility.

A number of mitigation measures have been proposed, which, if implemented and maintained, will reduce the significance of the certain visual impacts associated with the proposed wind energy facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. The anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent. As such, the facility would be considered to be acceptable from a visual perspective.

9.7 Assessment of Potential Noise Impacts

9.7.1 Relevant Noise Receptors

There are no residential communities close to the proposed development. The study area has a rural character in terms of the background sound levels. Potentially Sensitive Receptors (PSRs), also known as Noise-Sensitive Developments (NSDs) were initially identified using Google Earth®, supported by a site visit to confirm the status of the identified dwellings.

The reason for the site visit, apart from sampling ambient sound levels, is that there could be a number of derelict or abandoned dwellings that could be seen as a sensitive receptor, or small dwellings that could not be identified on the aerial image, or those that were built after the date of the aerial photograph.

Potential receptors in and around the proposed wind energy facility were identified and are presented in **Figure 9.13**. The locations of the PSRs are defined in the Noise study (**Appendix L**).

It should be noted that no NSD are situated closer than 1,200 meters from the closest wind turbines relevant for Soetwater Wind Farm (and all three phases of the development). It should be noted that NSD 10 is a derelict building, and therefore is no considered a NSDs.

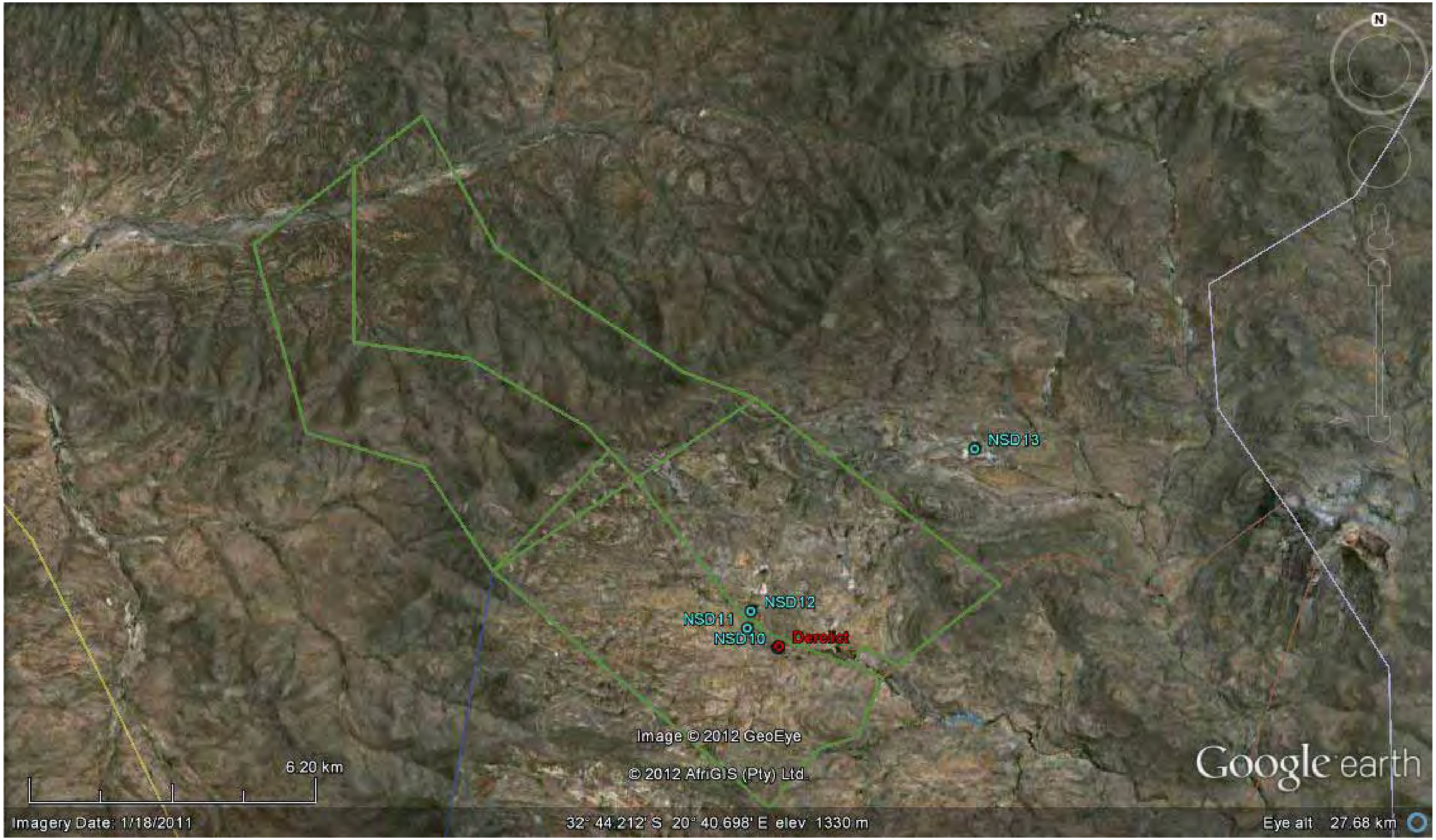

Figure 9.13: Aerial image indicating potential noise sensitive receptors and property boundaries in the proposed Soewater wind farm

9.7.2 Noise from Construction activities

Noise sources during construction include the following:

» **Construction equipment**
Construction equipment likely to be required will typically include excavator/graders, bulldozers, dump trucks, vibratory roller, bucket loader, rock breaker(s), drill rig, flat-bed truck(s), pile drivers, concrete trucks, cranes, fork lift(s) and various 4WD and service vehicles. Octave sound power levels typical for this equipment are presented in the Noise report.

» **Blasting**
Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. However, blasting will not be considered during the EIA phase for the following reasons:
  * Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use the minimum explosives and will occur in a controlled manner. The breaking of obstacles with explosives is also a specialized field and when correct techniques are used, causes significantly less noise than using a rock-breaker.
  * People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. However, these are normally associated with close proximity mining/quarrying.
  * Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties generally receive sufficient notice (siren) and the knowledge that the duration of the siren noise as well as the blast will be over relative fast results in a higher acceptance of the noise. Note that with the selection of explosives and blasting methods, noise levels from blasting is relatively easy to control

» **Traffic due to construction vehicles**
A source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the wind turbine. Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to additional traffic will be estimated using the methods stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise).

9.7.2.1 Results of Noise Modelling – Construction Noise

Only the calculated day time ambient noise levels are presented, as construction activities that might impact on sensitive receptors should be limited to the 06:00 – 22:00 time period. The worst-case scenario is presented with the entire activities taking place simultaneously during wind-still conditions, in good sound propagation conditions (20^{o}C and 80% humidity).

Even though construction activities are projected to take place only during day time, it might be required at times that construction activities take place during the night (particularly for a large project). Below is a list (and reasons) of construction activities that might occur during night time:

» Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
» Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore it is hard to judge beforehand if a construction team would be required to work late at night.

As it is unknown where the different activities may take place, it was selected to model the impact of the noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise impact) at all locations where wind turbines may be erected, calculating how this may impact on potential noise-sensitive developments as well as mapping this modelled construction activity over distance. Noise created due to linear activities (roads) were also evaluated and plotted against distance as illustrated below.

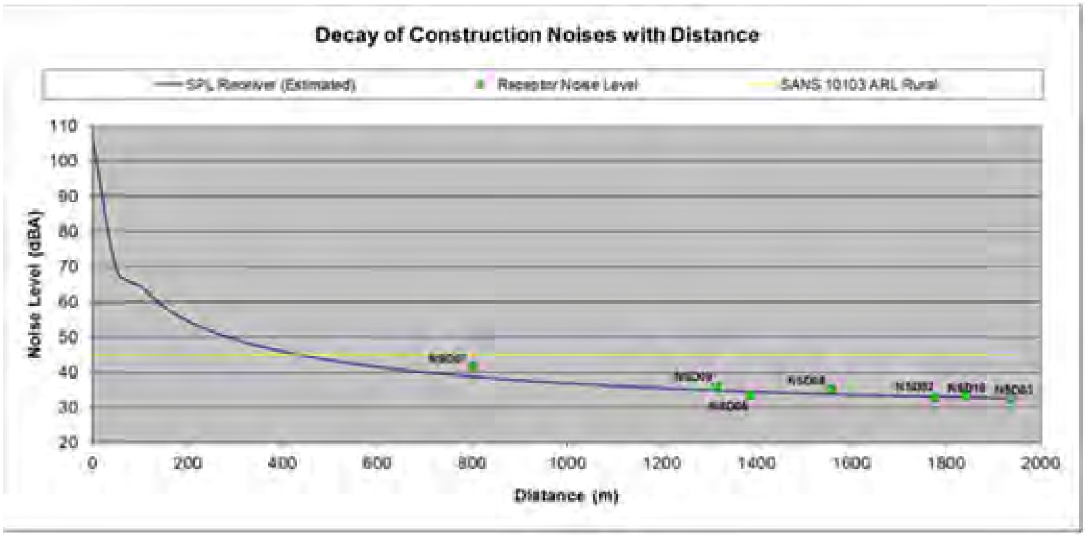

Figure 9.14: Construction noise: Projected Construction Noise Levels as distances increase between NSDs and locations where construction can take place

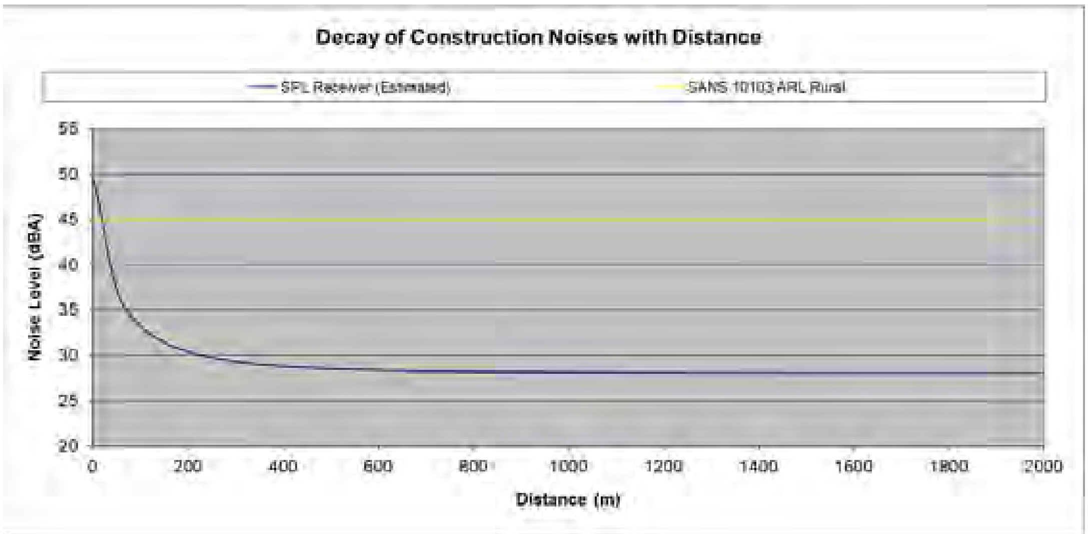

Figure 9.15: Construction noise: Projected Road Traffic Noise Levels as distances increase between NSDs and access roads (5 LDV and 5x Trucks travelling at 50 km/hr on a gravel road)

9.7.2.2 Impact tables summarising the significance of noise impacts (with and without mitigation) during Construction

Nature: Numerous simultaneous construction activities that could impact on PSRs.	
Acceptable Rating Level	Rural district with little road traffic: 45 dBA outside during day. Us of $L_{Req,d}$ of 45 dBA for rural areas.
Extent ($\Delta L_{Aeq,d}$>7dBA)	**Regional** – Change in ambient sound levels would extend further than 1,000 meters from activity **(3).**
Duration	**Temporary –** *Noisy activities in the vicinity of the receptors would last a portion of the construction period* **(1).**
Magnitude	**Low (2).**
Probability	**Improbable (1).**
Significance	**Low (10)**
Status	Negative.
Reversibility	High
Irreplaceable loss of resources?	Not relevant.
Can impacts be mitigated?	Yes, though mitigation not required.
Mitigation:	The following mitigation may be used: » Ensure a good working relationship between the developer and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potential sensitive receptor(s) include: o Proposed working times; o how long the activity is anticipated to take place; o what is being done, or why the activity is taking place; o contact details of a responsible person where any complaints can be lodged should there be an issue of concern. » When working near (within 500 meters – potential construction of access roads and trenches) to a potential sensitive receptor(s), limit the number of simultaneous activities to the minimum as far as possible; » When working near to potentially sensitive receptors, coordinate the working time with periods when the receptors are not at home where possible. » Potential receptors are most likely at school or at work, minimizing the probability of an impact happening; » Normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening. » Technical solutions to reduce the noise impact during the

	construction phase include: o Using the smallest/quietest equipment for the particular purpose. For modelling purposes the noise emission characteristics of large earth-moving equipment (typically of mining operations) were used, that would most likely over-estimate the noise levels. The use of smaller equipment therefore would have a significantly lower noise impact; o Ensuring that equipment is well-maintained and fitted with the correct and appropriate noise abatement measures.
Cumulative impacts:	This impact is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area.
Residual Impacts:	This impact will only disappear once construction activities cease.

9.7.3 Noise Sources: Operational Phase

Noise emitted by wind turbines can be associated with two types of noise sources:

» Aerodynamic sources: due to the passage of air over the wind turbine blades; and
» Mechanical sources that are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc. These sources generally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the substations themselves, traffic (maintenance) as well as transmission line noise.

» **Noise from the Wind Turbines: Aerodynamic sources[22]**
Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:
 o Self noise due to the interaction of the turbulent boundary layer with the blade trailing edge
 o Noise due to inflow turbulence (turbulence in the wind interacting with the blades)
 o Discrete frequency noise due to trailing edge thickness
 o Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade)
 o Noise generated by the rotor tips

[22] *Renewable Energy Research Laboratory, 2006; ETSU R97: 1996*

These types of noise are discussed in more detail in the Noise Impact Assessment report contained in Appendix L.

9.7.5.1 Results of Noise Modelling – Operational Phase for Soetwater Wind Farm

The Noise study focuses on the impacts on the surrounding sound environment during times when a quiet environment is highly desirable. Noise limits are therefore appropriate for the most noise-sensitive activity, such as sleeping, or areas used for relaxation or other activities (places of worship, school, etc.).

Appropriate Zone Sound Levels are therefore important, yet it has been shown that the SANS recommended (fixed) Night Rating Level ($L_{Req,N}$ = 35dBA) might be inappropriate due to the increased ambient sounds relating to wind action. A more appropriate method to determine the potential noise impact would be to make use of the projected noise levels due to the operation of the wind energy facility as well as the likely ambient sound levels due to wind induced noises.

Based on the preceding figures it is obvious that the risk of a noise impact developing is very low. The operation of the Soetwater Wind Farm will not have a noise impact on any of the current noise-sensitive developments. The change in ambient sound levels is illustrated in **Figure 9.16.**

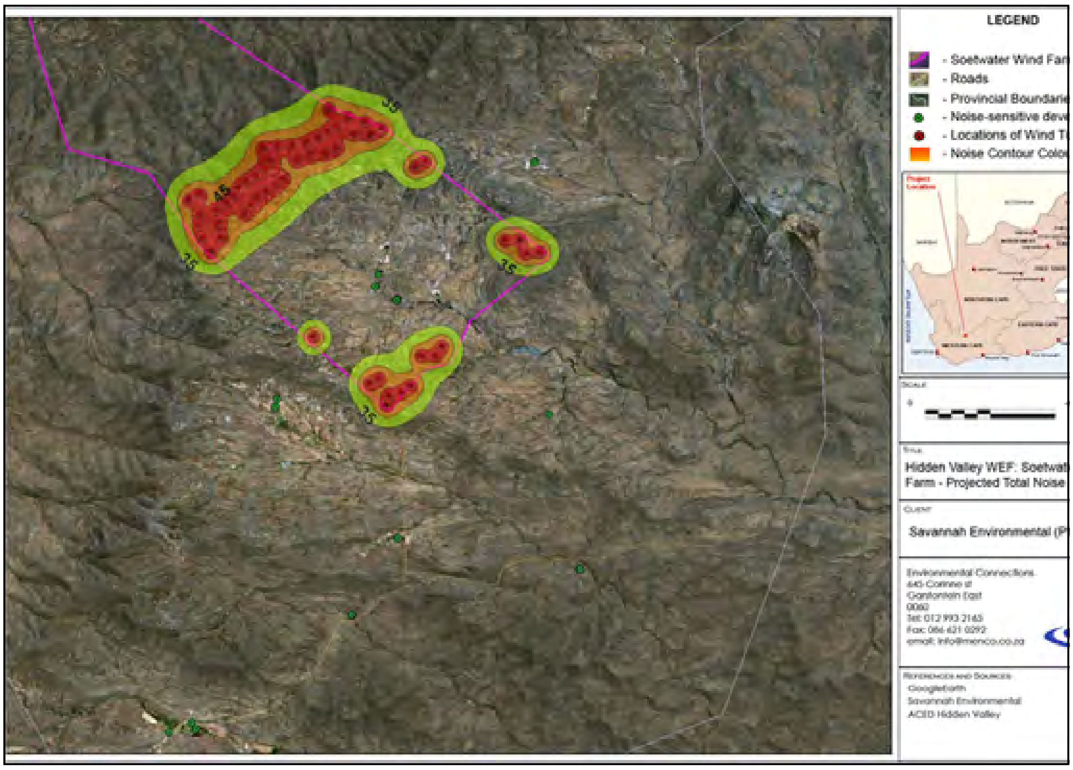

Figure 9.16: Projected Noise Levels (ISO model) from Soetwater wind turbines; Contours of constant sound levels for a 5 m/s wind (WTGs marked as red dots, PSRs as green dots)

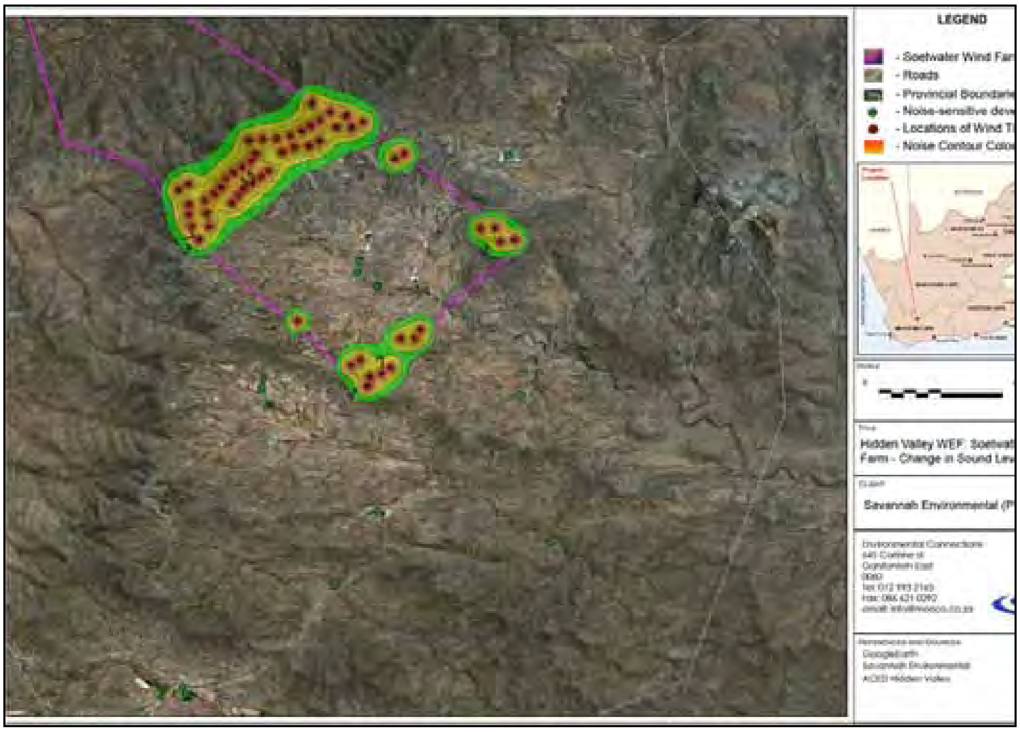

Figure 9.17 Change in ambient sound levels (ISO model), contours of constant noise levels for a 5 m/s wind (turbines marked as red dots, NSDs as green dots)

9.7.5.2 Impact tables summarising the significance of noise impacts (with and without mitigation) from the wind turbines – operational phase

Nature: Numerous turbines operating simultaneously during a period when a quiet environment is desirable.	
Acceptable Rating Level	Rural district with little road traffic. Refer to **Error! Reference source not found.** for the proposed Night Rating Level that varies with wind speed.
Extent ($\Delta L_{Aeq,n}$>7dBA)	Local – Impact will extend less than 1,000 meters from activity. (2).
Duration	Long – Facility will operate for a number of years (4).
Magnitude	Low (2) – for all current NSD
Probability	Improbable (1) for all current NSD
Significance	***8 (Low) for all current NSD using the Vestas V90 3.0 MW turbine***
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Can impacts be mitigated?	No noise impact, mitigation not required
Mitigation:	No mitigation required.
Cumulative impacts:	This impact is cumulative with existing ambient background noises.
Residual Impacts:	This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.

9.7.4 Comparative Assessment of Grid Connection Options

There will be no differences in the significance of noise impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a noise perspective.

9.7.5. Cumulative impacts

The section specifically looks at the potential cumulative noise impact with all three phases operational (Karusa, Soetwater and Great Karoo Wind Farms). The wind turbine used for the modelling is the Vestas V90 3.0MW turbine (operating in mode 0) with the relevant octave sound power levels. A wind rose obtained from the developer indicates that the wind direction is predominantly north-west. Additional modelling will therefore be done for this wind speed using the Concawe model.

Cumulative projected Noise Levels in the area due to the operation of the entire Hidden Valley Wind Energy Facility are illustrated in the figures below (ISO model for a 5 m/s wind). **Figure 9.18** illustrates the projected cumulative noise levels due to the operation of the proposed Hidden Valley Wind Energy Facility with all three wind farms operating, with **Figure 9.19** illustrating how these operating wind farms may alter the environmental ambient sound levels.

Those figures only illustrate and evaluate the potential noise impact for a 5 m/s wind speed. A more appropriate method to determine the potential noise impact would be to make use of the projected noise levels due to the operation of the wind energy facility for all wind speeds as illustrated in **Figures 9.19 and 9.19.**

Using the model parameters as outlined in the noise report, the following can be concluded:

» As was seen with the Great Karoo Wind Farm, the is a possible risk that the larger Hidden Valley wind energy facility may have a noise impact of a low-medium magnitude, mainly due to the distance to wind turbines 143 (804 meters) and 140 (948 meters).
» The operation of this wind energy facility will have no noise impact on any other NSD.
» With the input data as used, this assessment indicated that the cumulative operation of all wind turbines will have an ***insignificant noise impact***.

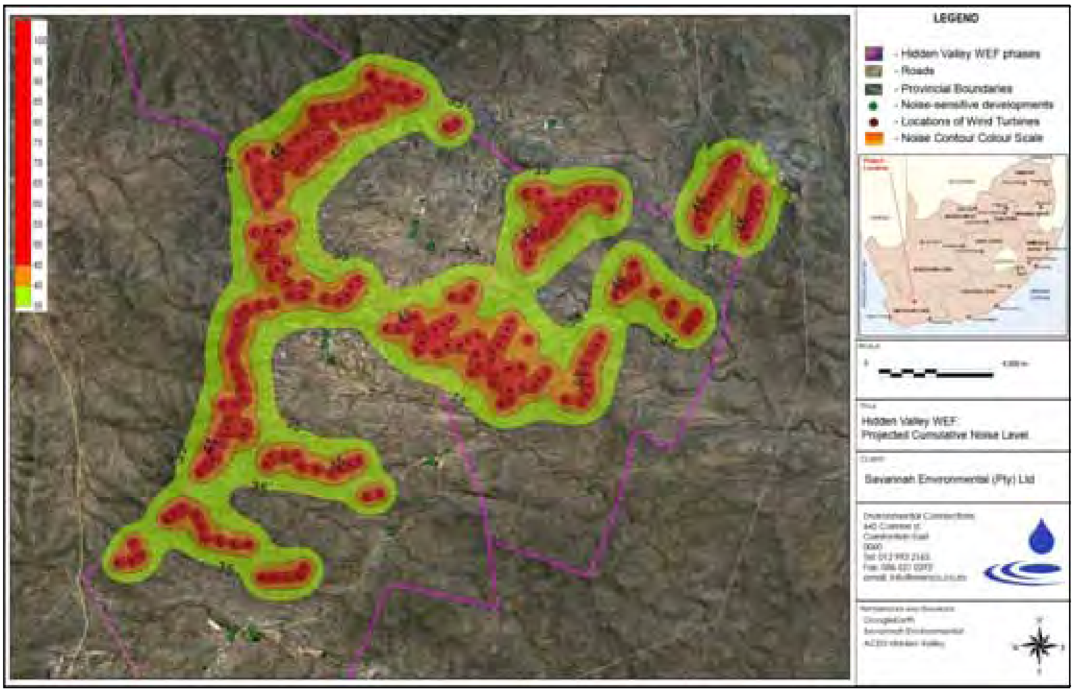

Figure 9.18: Projected Cumulative Noise Levels (ISO model) from Hidden Valley wind energy facility; Contours of constant sound levels for a 5 m/s wind

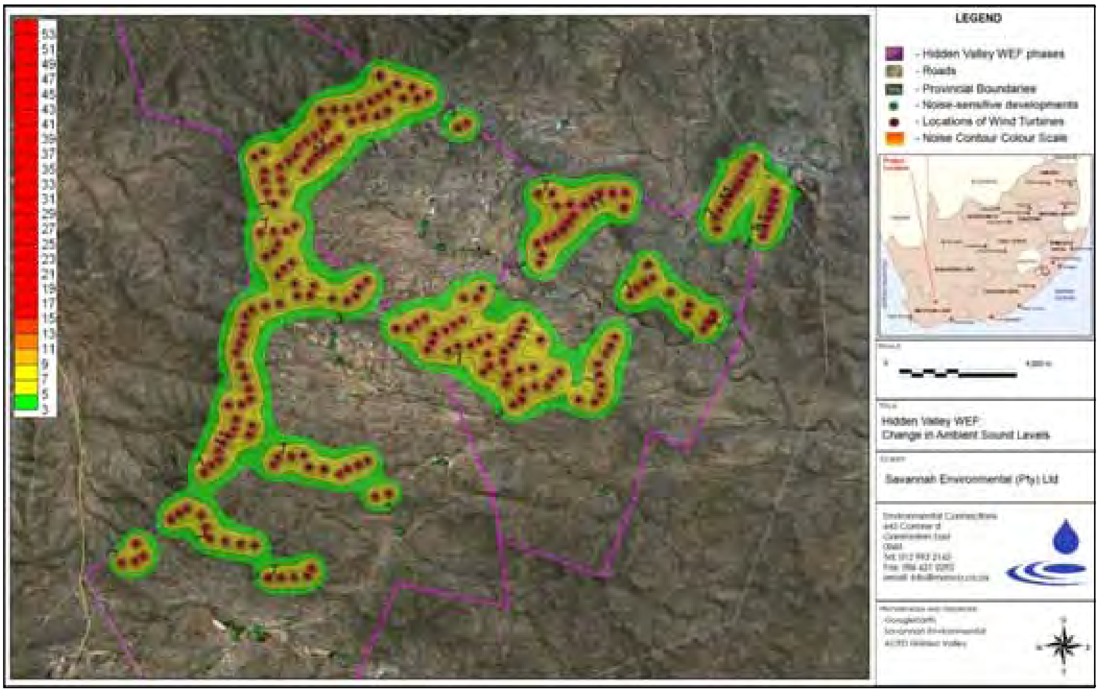

Figure.9.19: Projected change in ambient sound levels (ISO model); Contours of constant sound levels for a 5 m/s wind

Should the three other approved wind projects be developed, along with the Hidden Valley project, the cumulative impacts will have to be considered in a larger noise study, to be arranged by the relevant developers, as a joint effort, and based on final turbine layouts, as it is too difficult to predict at this stage.

9.7.9 Conclusions and Recommendations

By making use of predictive models to identify noise issues of concern, the noise assessment indicated that the proposed project will have a noise impact of low significance on all NSDs in the area during both the construction and operational phases using the Vestas V90 3.0MW wind turbine. However, mitigation measures are still proposed to reduce the potential noise impacts and risks to receptors.

With the input data as used, this assessment indicated that the proposed project will have a noise impact of a ***low significance*** on all current NSD in the area during both the construction and operational phases using the Vestas V90 3.0MW wind turbine for all wind speeds.

It should be noted that the noise impact was determined based on the outcome of a regression analysis that indicated that the likely long-term ambient sound levels could be significant during periods when wind speeds exceeds 4 m/s. The regression analysis is based on a number of measurements taken at various sites during periods when the wind was blowing, but when there were little other noise sources. As such it is recommended that the developer implement a monitoring programme before the development of the wind energy facility confirming the validity of the regression analysis of non-site specific data. It is therefore recommended that the ambient sound environment be defined over a longer period as per the environmental management programme.

In addition quarterly noise monitoring should be conducted by an acoustic consultant for the first year of operation. This monitoring is to take place over a period of 24 hours in 10 minute bins, with the resulting data co-ordinated with wind speeds as measured at a 10 meter height. These samples should be collected when the Wind Turbines are operational. Quarterly monitoring is recommended at NSD07 for the first year, as well as any other NSDs that have complained to the developer regarding noise originating from the facility.

Annual feedback regarding noise monitoring should be presented to all stakeholders and other Interested and Affected parties in the area. Noise monitoring must be continued as long as noise complaints are registered.

The findings of this report should also be made available to all potentially noise-sensitive developments in the area, or the contents explained to them to ensure that they understand all the potential risks that the development of a wind energy facility may have on them and their families.

With its potential for environmental and economic advantages, wind power generation has significant potential to become a large industry in South Africa. However, when wind farms are near to potential sensitive receptors, consideration must be given to ensuring a compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time the wind farms need to reach an optimal scale in terms of layout and number of units.

Wind turbines produce sound, primarily due to mechanical operations and aerodynamics effects at the blades. Modern wind turbine manufacturers have virtually eliminated the noise impact caused by mechanical sources and instituted measures to reduce the aerodynamic effects. But, as with many other activities, the wind turbines emit sound power levels at a level that can impact on areas at some distance away. When potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors.

It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source – but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels.

9.8 Assessment of Potential Impacts on Heritage - Archaeology

9.8.1 Impact of Construction on Pre-colonial Archaeology

The following heritage sites have been identified on the Soetwater Wind Farm site and are shown in **Figure 9.20**:

» Dry Packed Stone Walling Dwelling on Portion 1 of the Farm Orange Fontein 203
» Farmstead Complex on Portion 1 of the Farm Orange Fontein 203
» Clay Packed Stone Walling Cottage on remainder of Portion 1 of the Farm Orange Fontein 203 (CottageRuins)
» Dry Packed Stone Walling Kraal on remainder of Portion 1 of the Farm Orange Fontein 203

None of the proposed wind turbines occur on these heritage sites, and it recommended that associated infrastructure (such as access roads) avoid these heritage sites. The NHRA stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

» Grade I: Heritage resources with qualities so exceptional that they are of special national significance;
» Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
» Grade III: Other heritage resources worthy of conservation on a local authority level.

The occurrence of sites with a Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the applicable mitigation measures would allow the development activities to continue. **All the heritage sites below have been classified as Grade III sites.**

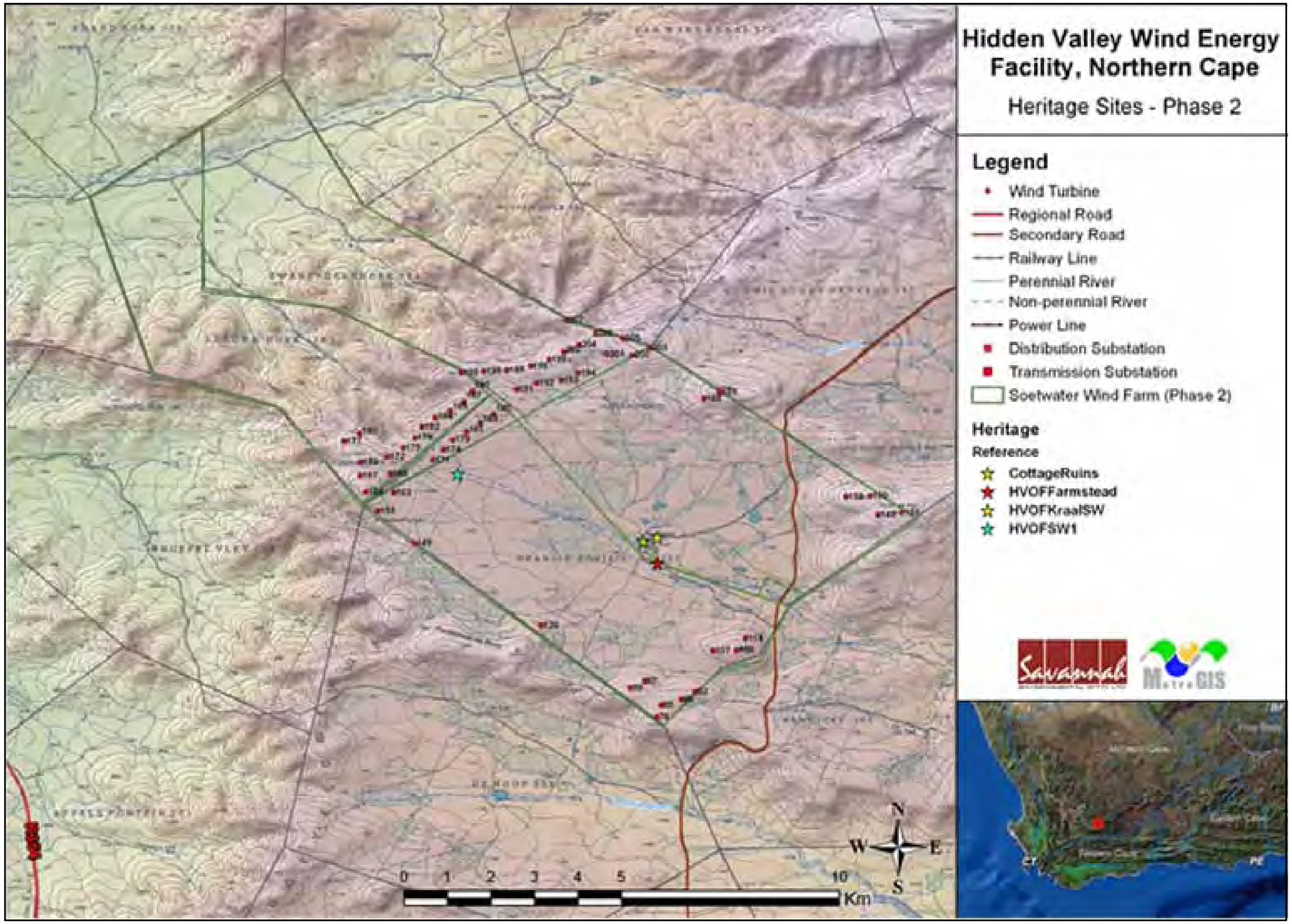

Figure 9.20: Grade III Heritage sites identified on the Soetwater Wind Farm site

9.8.1.1 Impact Table – Impact of Construction on heritage artefacts

Nature: The destruction of identified heritage sites during the construction of the turbines, substation, cabling between the turbines, access roads and workshop.		
	Without mitigation	**With mitigation**
Extent	Local (5)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very High (10)	Moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (60)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	None	Low
Irreplaceable loss of resources?	Yes	Low
Can impacts be mitigated?	Yes	Yes
Mitigation: » A 10m perimeter boundary fence must be established around the sensitive heritage structures (Dry Packed Stone Walling Dwelling on Portion 1 of the Farm Orange Fontein 203 (HVOFSW1) adjacent to the farm gravel road before and during all construction and development activities. » If concentrations of archaeological materials are exposed during construction then all work must stop for an archaeologist to investigate. If any human remains (or any other concentrations of archaeological heritage material) are exposed during construction, all work must cease and it must be reported immediately to the nearest museum/archaeologist or to the South African Heritage Resources Agency, so that a systematic and professional investigation can be undertaken. Sufficient time should be allowed to investigate and to remove/collect such material. Recommendations will follow from the investigation.		
Cumulative impacts: » Irreplaceable loss of historical heritage resources.		
Residual impacts: » Irreplaceable loss of historical heritage resources.		

9.8.8.3 Comparative Assessment of Substation Options

There will be no differences in the significance of heritage impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a heritage impact perspective.

9.8.4. Cumulative impacts

There are heritage sites on all three development phases, therefore is these sites are destroyed during construction, there would a net increase in negative impacts on heritage artefacts. With mitigation, the impacts are of acceptable level. The same goes for the three other approved projects in the region.

9.8.5. Conclusions and Recommendations

No heritage sites occur within the development footprint of the proposed for infrastructure for the Soetwater Wind Farm. However, historical archaeological remains, features and sites were documented and have been reported in the Phase 1 archaeological impact assessment (AIA). These sites occur in the broader farm portion. These remains, features and sites have been highlighted as they occur adjacent to the possible main access roads that will be used during the construction and development activities.

The site therefore has a medium-high cultural sensitivity according to the sensitive heritage remains, features, and site encountered, the following recommendations are made:

» A professional archaeologist (with an already authorised collection permit – if necessary) must be appointed during construction to monitor and identify possible archaeological material remains and features that may occur below the surface and make further appropriate recommendations on removing and / or protecting the archaeological material remains and features.
» If concentrations of archaeological heritage material and human remains are uncovered during construction, all work must cease immediately and be reported to the Albany Museum (046 622 2312) and/or the South African Heritage Resources Agency (SAHRA) (021 642 4502) so that systematic and professional investigation/ excavation can be undertaken.
» Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites.
» A 10m perimeter boundary fence must be established around the identified sensitive heritage structures adjacent to the farm gravel road before and during all construction and development activities.

9.9 Assessment of Potential Impacts on Palaeontology

9.9.1. Findings or Loss of Fossils during Construction

The construction phase of the wind energy facility will entail excavations into the superficial sediment cover (soils, etc.) and perhaps also into the underlying bedrock. These include excavations for the turbine foundations, buried cables, new internal access roads and foundations for associated infrastructure such as an on-site substation and workshop / administration building. In addition, sizeable areas of potentially fossiliferous bedrock may be sealed-in or sterilised by infrastructure such as hard standing areas for each wind turbine, lay down areas and internal access roads. All these developments may adversely affect potential fossil heritage within the study area by damaging, destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good. Once constructed, the operational and decommissioning phases of the wind energy facility will not involve further adverse impacts on palaeontological heritage.

The site is associated with continuous Permian-age sedimentary strata that cover large geographical areas, as well as more recent Quaternary- age alluvial and superficial valley fill deposits that occur as localized events. The area within which the wind energy facilities are to be constructed is primarily underlain by *in situ* strata of the fossil-bearing Abrahamskraal Formation (*Pa*). Quaternary alluvial deposits, especially near water courses and drainage lines, have the potential to yield microfossil and fossil mammal remains as well as Early Stone Age archaeological remains. The proposed development located within igneous bedrock (dolerite) represents no paleontological impact.

In general, the destruction, damage or disturbance out of context of fossils preserved at the ground surface or below ground that may occur during construction represents a negative impact that is limited to the development footprint. Such impacts can usually be mitigated but cannot be fully rectified (i.e. permanent). Because of the generally sparse occurrence of fossils within most of the formations concerned as well as within the overlying superficial sediments (soil, etc.), as inferred from better exposed localities elsewhere, the magnitude and probability of impacts are conservatively rated as low.

The overall impact significance of the construction phase of the proposed wind farm project is assessed as low (negative) without mitigation. It should be noted that, should fossils be discovered before or during construction and reported by the responsible ECO to the responsible heritage management authority (SAHRA) for professional recording and collection, as recommended here, the overall impact significance of the project would be further reduced. Residual negative impacts from any loss of fossil heritage would be partially offset by an improved palaeontological database as a direct result of appropriate mitigation. This is a positive outcome because any new, well-recorded and suitably curated fossil material from this palaeontologically under-recorded region would constitute a useful addition to our scientific understanding of the fossil heritage here.

The intent of mitigation and lessening of impact is to identify fossil localities for future avoidance or to recover in situ fossils before possible damage or destruction. However, effective mitigation of potential paleontological impact for this project is only feasible once the final positions of all individual structures and access roads have been finalised.

9.9.1.1 Impact Table – Impact on fossil heritage resources during the construction phase

Nature: Construction of the turbines, underground electrical grid, substation, associated building structures and access roads will impact on fossil-bearing sediments composed of Abrahamskraal Formation strata (Adelaide Subgroup). These sediments are regarded as of high overall paleontological significance, especially with regard to potential impact on vertebrate, invertebrate, plant and trace fossils. Late Quaternary alluvial and valley fill deposits in the area, especially near water courses and drainage lines, are of moderate overall paleontological significance and have the potential to yield fossil mammal remains as well as Early Stone Age artefacts. Potential paleontological heritage identified in the affected area could be negatively affected during the construction phase of the development.

	Without mitigation	**With mitigation**
Extent	Local High (5)	Local Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Moderate (6)
Probability	Probable (3)	improbable (2)
Significance	**Medium (50)**	**(Low) 24**
Status (positive or negative)	Negative	Positive
Reversibility	Improbable	Possibility
Irreplaceable loss of resources?	High	High
Can impacts be mitigated?	Yes	

Mitigation:

» Monitoring of areas where the concrete foundations for each turbine will be placed, where underground cables connecting the turbines with the substation will be placed, where the substation and office facilities will be constructed and where access roads will be located to provide access to each turbine site, **before** the commencement of development.

» 2) Monitoring of fresh exposures and bedrock excavations into the fossil-bearing strata **during** the construction phase of development.

9.9.2 Comparative Assessment of Substation Alternatives

There will be no differences in the significance of fossil heritage impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a fossil impact perspective.

9.9.4. Cumulative impacts

The cumulative impact on fossils from the Soetwater Wind Farm, and the other two phases, will not have a significant impact on palaeontology.

9.9.5. Conclusions and Recommendations

The proposed development located within igneous bedrock (dolerite) represents no major paleontological impact.

CONCLUSIONS AND RECOMMENDATIONS FOR PHASE 2 – SOETWATER WIND FARM CHAPTER 10

Soetwater Wind Farm (Pty) Ltd is proposing to establish a commercial wind energy facility and associated infrastructure on a site located within the Karoo Hoogland Local Municipality. The site is located within the Karoo Hoogland Local Municipality (approximately 30 km south of Sutherland in the Northern Cape Province). ***This Chapter of the EIA report deals only with the conclusions and recommendations of the EIA for the Phase 2 of the larger "Hidden Valley Wind Energy Facility" referred to as the Soetwater Wind Farm (DEA Reference Number: 12/12/20/2370/2).***

The Soetwater Wind Farm is proposed on the following farm portions (which collectively occupies land of 95.3 km^2 in extent):

» The remainder of and Portion 1, 2 and 4 of Farm Orange Fontein 203 and Annex Orange Fontein 185
» Farm Leeuwe Hoek 183
» Farm Zwanepoelshoek

The primary components of the Soetwater Wind Farm include the following:

» Up to 56 **wind turbines**, appropriately spaced to make use of the wind resource on the site. The generating capacity of the facility will depend on the final turbine selected for implementation but will be limited to 140MW at the point of connection with the Eskom grid. The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.
» Each wind turbine is expected to consist of a concrete foundation (20m x 20m), a steel or concrete tower, a hub (between 80m and 120m above ground level, depending on the turbine size decided upon) and three blades with a rotor diameter of up to 120m.
» Cabling between the components, laid approximately 1 m underground where feasible. In as far as possible, cabling will follow the internal access roads.
» Internal roads (approximately 8m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines and the vast areas of the site which are not currently accessible will necessitate the construction of ~28 km of new access roads in some areas.
» A new 132 kV **substation** complex and a new 132 kV power line that will connect into a proposed 400 kV substation (located on the Karusa wind farm –

Phase 1 of the Hidden valley project). Two alternative substation locations and associated power lines have been considered. This proposed substation will have a high-voltage (HV) yard footprint of approximately 200m x 200m.

» **Operations and service building area** for control, maintenance and storage (approximately 2000m^2).
» **Guard house** for access security of 50m$^{2.}$

The environmental impact assessment (EIA) for the proposed Soetwater Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice 33306, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998) and the EIA Regulations of June 2010 (as amended).

The EIA Phase aimed to achieve the following:

» Provide an overall assessment of the social and biophysical environments affected by the proposed development forward as part of the project.
» Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed wind energy facility.
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

The purpose of this amended Final EIA Report for the Hidden Valley Wind Energy Facility is to include the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes as well as updating the project information where necessary.

10.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices F - S provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the proposed project. This chapter concludes the EIA Report by providing a summary of the conclusions of the assessment of the proposed site for the wind energy facility and the associated infrastructure such as the substation and overhead power line. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental team during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project.

The assessment of potential environmental impacts presented in this report is based on a preliminary layout of the turbines and associated infrastructure provided by Soetwater Wind Farm (Pty) Ltd. This layout includes 56 wind turbines as well as associated infrastructure. Subsequent to the bird and bat monitoring surveys the turbine count has been repositions in response to assessments and specialist recommendations (this is discussed in detail in the Mitigation Section 10.5.1). No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of medium to high significance were identified which require mitigation (thereafter the impacts can be reduced to medium – low significance). Mitigation to avoid impacts is primarily associated with the relocation (or in some instances, the elimination) of certain turbine positions of concern, as well as measures during the construction phase to prevent negative impacts from occurring. Relocation mitigation has been implemented. Mitigations are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental **Management Programme (EMPr)** included within **Appendix O**.

The sections which follow provide a summary of the most significant environmental impacts associated with the proposed project, as identified through the EIA.

10.2. Summary of All Impacts

As a summary of the potential impacts identified and assessed through the EIA process in terms of the preliminary layout of 56 turbines and associated infrastructure, Table 10.1 indicates the significance ratings for the potential biophysical, ecological, visual and social impacts.

As indicated in Chapter 3, the significance weightings for potential impact have been rated as follows:

- **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
- **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)
- **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

Table 10.1: Summary of potential impacts identified and assessed through the EIA process

Nature	**Without mitigation**	**With mitigation**
Impacts on Ecology		
Loss or fragmentation of indigenous natural vegetation	Medium	Medium
Impact on threatened plants	Medium	Medium
Impact on Wetlands	High	Low
Impact on threatened animals species / habitat	Low	Low
Alien vegetation growth due to disturbance	Medium	Low
Impacts on Avifauna		
Bird mortalities due to collisions with wind turbines	Medium	Medium
Impact on birds due to disturbance	Medium	Medium
Loss of avifauna habitat	Medium	Low
Electrocution/ collision of birds with the power line	Medium	Low
Impacts on Bats		
Bat mortalities due to direct blade impact or barotrauma during foraging	High	Low
Bat mortalities due to direct blade impact or barotrauma during migration	Medium	Low
Destruction of bat roosts during construction	Low	Low
Impacts on Soil, Land Use, Land Capability and Agricultural Potential		
Loss of land with high agricultural potential and land capability	Low	Low
Soil Erosion / degradation during Construction	Medium	Low
Soil contamination / soil erosion during the operation of the facility	Low	Low
Social Impacts		
Creation of Employment and Business Opportunities during the Construction Phase	Medium	Medium
Impact of the presence of construction workers in the area on local communities	Low	Low
Risk of Stock theft and damage to farm infrastructure	Medium	Low
Increased risk of fires during construction	Medium	Low

Increases traffic on roads due to construction	Low	Low
Operational Phase -Creation of Long- Term employment and business opportunities	Low	Medium
Contribution of the project towards Development of Renewable Energy Infrastructure in South Africa	Medium	Medium
Long-Term Impact of the project on Existing Farming Activities on the Site	Low	Low
Impact of the wind energy facility on tourism in the region	Medium	Medium
Health Impacts due to the Operation of the wind energy facility	Low	Low
Visual Impacts		
Change in visual character and sense of place	Moderate	N/A
Visual impact of lighting at night on visual receptors in close proximity to the proposed facility	Medium	Medium
Shadow Flicker	Low	Low
Noise Impacts		
Noise impacts due to construction activities	Low	Low
Noise impacts from the wind turbines – operational phase	Low	Low
Impacts on Heritage Artefacts		
Impact of construction on pre-colonial archaeology	Medium	Low
Potential Impacts on Palaeontology		
Findings or Loss of Fossils during Construction	Medium	Low

10.2.1. Quantification of Areas of Disturbance on the Site

Site-specific impacts associated with the construction and operation of the proposed wind energy facility relate to the direct loss of vegetation and species of special concern, disturbance of animals and loss of habitat and impacts on soils. A wind energy facility is, however, dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. A site of 95.3 km^2 was considered for the facility, of which less than 1 % will be utilised for the wind energy facility. The bulk of this effective area required for the facility footprint would not suffer any level of disturbance as a result of the required activities on site. This is explained further below.

Permanently affected areas comprise 56 turbine footprints (56 foundation areas of 20m x 20m), access roads (up to 8 m in width), one 132 kV substation footprint (200m x 150 m) and an operations and service building area (200m^2). The area of permanent disturbance is approximated as follows:

Facility component - permanent	**Approximate area/extent (in m^2)**
56 turbine footprints (each circa 20m x 20m)	22 400
Permanent access roads within the site (6 m in width)	110 000
One on-substation footprint (200m x 200 m)	40 000
Operations and service building area (100m x 100m)	10 000
TOTAL	182 400m^2 (of a total area of 95 300 000 m^2) **i.e. 0.2% of site**

Temporarily affected areas comprise 56 foundation areas, laydown areas for turbines (each laydown area assumed to have a footprint of 60 m x 60 m) and possibly a track of 11 m in width if a crawler crane is required to move across the site (i.e. an additional 8 m width to the permanent road of 6 m in width). The use of a crawler crane is not desirable and will be avoided if at all possible. The area of temporary disturbance is as follows:

Facility component - temporary	**Approximate area/extent (in m^2)**
56 turbine laydown areas (60 m x 60m)	201 600
TOTAL	201 600(of a total area of 95 300 000 m^2) = **0.2 % of site**

Therefore, less than 1% of the entire site can be anticipated to be disturbed to some extent during the construction and operation of the Soetwater Wind Farm.

10.3 Comparative Assessment of Grid Connection Alternative

The position of the substation (and the alternative power line) is related to the point of connection to the Eskom grid via the 132 kV substation). The two alternatives for gird connection are as follows:

- Substation Option 1 is located on Farm Orangefontien. Option 1 is technically preferred.
- Power line Option 1 is 17 km in length and connects Soetwater Substation Option 1 with the preferred 400 kV substation (Karusa Substation Option 1 located on Farm Standvastigheid, on the Karusa site). The power line is proposed to cross the Farms 206, 209 and 207 to connect at the new 400 kV substation located on the Karusa site.
- Substation Option 2 is located on Farm Orangefontien.
- Power line Option 2 is 13 km in length and connects Soetwater Substation Option 2 with the preferred 400 kV substation (Karusa Substation Option 2 located on the Karusa site). The power line is proposed to cross the Farms 185, 202 to connect at the proposed new 400 kV substation located on Farm 209 on the Karusa site.

Note that the Soetwater power lines connect via Phase 1 (Karusa) power lines and into Komsberg substation. A comparative assessment of the two substation location and grid connection alternatives is summarised in **Table 10.2**. Based on the comparative assessment Soetwater Substation 1 and power line 1 is slightly less environmentally sensitive than the alternative, therefore Soetwater **substation and power line Option 1 is nominated as the preferred alternative from an environmental perspective.**

Table 10.2: Comparison of recommendations for Grid Connection Options

	Soetwater Substation Option 1 and linked Power line Option 1 (Technically preferred)	**Soetwater Substation Option 2 (Alternative) and linked Power line Option 2**
Ecology (Flora)	» **Both options are acceptable**. Both grid connection options traverse a drainage line on Portion 1 of Farm Orangefontein. However, due to the width of the power line servitude (132kv = 36m), the impact will be marginal. Both power line and substation options occur in areas of medium ecological sensitivity. Therefore both grid connection options will have a similar impact on the ecological environment. With the use of mitigation measures during construction, both grid connection options are acceptable, with no preference from an ecological perspective.	
Avifauna	» Power line Option 1 is 17 km in length and connects Substation Option 1. » Of the 2 grid connection options, **Option 2 is slightly preferred** as it crosses near to a farm dam. » However, both options may be considered, if avifauna collision mitigation is used, i.e. “bird flight diverters” are fitted to the sections of line which have been mapped as either high and medium avifaunal sensitivity and as verified by a avifaunal “walkthrough” survey during the detailed design of the power line.	» Power line Option 2 is 13 km in length and connects to Substation Option 2. » Option 1 less preferred as it crosses near two farm dams which may be habitat for sensitive bird species.
<u>Bats</u>	» <u>No preference</u>	» <u>No preference</u>
Soils	» The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation alternatives in terms of impacts of soils or geology. » The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation alternatives in terms of impacts of soils or geology.	
Social	» No preference applicable in terms of social impacts, therefore both substation options are acceptable.	
Visual	» There will be no differences in the significance of visual impacts for any of the alternative substations. This is because the region in which the site is located is sparsely populated, with large distances between one homestead and the next. Furthermore, the visual landscape is already disturbed with the current 400 kV substation on the site as well as power lines.. Therefore either of the proposed alternatives are considered acceptable from a visual impact perspective.	
Noise	» There will be no differences in the significance of noise impacts for any of the alternative substation or power line routings. Both substations are further than 200m from noise receptors, therefore both options are acceptable in terms of transformer noise.	
Heritage	» Both substation options occur outside of the heritage sites and are therefore both acceptable from a heritage point of view.	
Palaeontology	» No preference between the alternatives.	

10.4 Cumulative Impacts

Based on the information available at the time of undertaking the EIA, there are other wind energy facilities proposed in the immediate region. These are listed in Table 8.2. Four authorised wind energy facilities are proposed in the immediate study area. None of the above-mentioned projects have preferred bidders status at the time of writing this EIA report. 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 be developed. It is considered that not all proposed developments will be granted the relevant permits by the relevant authorities (DEA, DoE, NERSA and Eskom) and this is because of the following reasons:

» There are limitations to the capacity of the existing Eskom grid.
» Not all applications will receive positive environmental authorisation.
» There are stringent requirements to be met by applicants.
» Not all proposed wind farms will be viable because of the wind resource.
» Not all wind farms will be able to reduce negative impacts to acceptable levels or able to mitigate adequately.
» Not all proposed wind farms may be granted a generation license by NERSA and sign a Power Purchase Agreement with Eskom.

There are currently no existing commercial wind farms or preffered bidder wind projects in the vicinity of the Hidden Valley site both on the Northern Cape and Western Cape side of the provincial boundary.

Table 8.2: Proposed wind farm developments in the vicinity of the Hidden Valley Site

Wind Farm (Developer)	**No. of turbines**	**Distance (km)**	**Status of the development**	**DEA Reference Number**
14. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Roggeveld	Authorisation received	12/12/20/1783
15. Witberg Wind Farm (G7 Renewable Energies)	Up to 27	Approx. 25km south of Roggeveld	Authorisation received	12/12/20/1966

16. Sutherland (wind and solar) (Mainstream SA)	293 to 386	Approx 35km north east o/f Roggeveld	Authorisation received	12/12/20/1782
17. Suurplaat Wind Farm 18. (Moyeng Energy)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received	12/12/20/1583
19. Roggeveld Wind Farm	Approximately 207	Adjacent to the Hidden Valley site (to the west)	EIA in process	12/12/20/1988/1-3
20. Gunstfontein	Approximately 100	Adjacent to the Hidden Valley site (to the north)	EIA in process	14/12 /16/3/3/2/399 (wind) 14/12/16/3/3/2/395 (solar)

The combined effect of the various wind farms proposed for this area will have a cumulative visual impact and impact on the landscape character. The significance of this cumulative impact is uncertain as at the time the assessment was undertaken the details of the final layouts of adjacent or neighbouring facilities were not available and could therefore not be quantitatively assessed. Cumulative impacts discussed below and have been considered within the detailed specialist studies, where applicable (refer to Appendices F - S):

The potential ***direct cumulative impacts*** as a result of the proposed project are expected to be associated predominantly with:

» *Visual impact* - This impact may be sequential and additive, due to the visibility of wind turbines from four or more within 10-20 km of each other. From a visual perspective, the overlapping viewsheds can be considered favourable, as it represents the consolidation and concentration of potential visual impacts within a clustered region (i.e. the development of a wind energy facility node, rather than dispersing the impact to other areas). In addition, this region of the Karoo is sparsely populated, with large distances between one farmstead and the next and between one town and the next.

» *Social* (linked to visual) - The establishment of four or more wind energy facilities in the area may impact negatively on the landscape and the areas rural sense of place and character. The cumulative impact will however to some extent be moderate due to the relatively low incidence of visual receptors in the region. On the other hand, cumulative positive socio-economic impacts from three or more wind energy facilities in terms of job creation and economic growth and development of infrastructure will occur in a local and district municipality that is in need of this growth and development may be significant.

» *Impact on SALT – The intensity of light generated by the wind energy facility is* expected to be of a lower order than that generated by the urban area of Sutherland due to the dispersed nature of the turbines. The distance of the SALT from the wind energy facility and the elevated position of the SALT reduce the significance of this impact to insignificant. The furthest extent of direct visibility of turbine hubs and lights in the direction (NE) of the SALT is 10km. The project may impact on (due to lighting) the day-to-day operations of the observatory. However, approval of the Hidden Valley wind project will be contingent on the developer's ability to prove that the facility will not contravene the provisions of the Astronomy Geographic Advantage (AGA) Act (2007).

The potential ***indirect cumulative impacts*** as a result of the proposed project are expected to be associated predominantly with:

» *Flora, fauna, and ecological processes* - (impacts that cause loss of habitat may exacerbate the impact of the proposed facility impact) at a regional level driven mostly by the possibility of other similar facilities being under construction simultaneously. Impacts related to disturbance, habitat loss and collision related mortality of avifauna may become cumulative if other wind energy facilities are developed in the region. Should the Hidden Valley project and the three other above-mentioned proposed wind projects in the Karoo region be developed, cumulative negative ecological impacts may occur. The significance of this impact is expected to be of a moderate significance and can result in a cumulative loss of biodiversity (particularly for protected plants and animal species and soil erosion). However, if negative impacts on ecology is effectively mitigated and managed for each project, through sound environmental management during construction and operation and by formal conservation and active management of the natural areas on site, then the negative impacts on ecosystems on each site can be within acceptable levels, and therefore in keeping with the principles of sustainable development. With the implementation of good environmental management practise during the life cycle of each project, cumulative impacts on ecology as a result of the establishment of various wind energy facilities in the area could be of an acceptable level.
» *Avifauna* - The cumulative effect of four or more wind energy facilities on bird species of conservation concern may be moderate to high, without mitigation. It is, therefore, imperative that pre-construction and post-construction monitoring is implemented on each site using any accepted or endorsed bird

monitoring guidelines or standards to provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. Turbines should be carefully placed outside of sensitive areas as is the case on the Soetwater Wind Farm. This will provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. At this stage, indications are that displacement may emerge as a significant impact, particularly for target species such as Ludwig's Bustard Black Stork, Southern Black Korhaan, Martial Eagle, Jackal Buzzard, Greater Flamingo, Lesser Kestrel and assorted waterfowl, and waders. In some cases, these species serve as surrogates for other similar species, examples being Lesser Kestrel for Rock Kestrel, and Southern Black Korhaan or Karoo Korhaan. Collision rates may appear relatively low in many instances, however cumulative effects over time, especially when applied to large, long lived, slow reproducing and/or threatened species (many of which are collision-prone), may be of considerable conservation significance. Furthermore, when viewed in isolation, one wind energy facility may pose only a limited threat to the avifauna of the region. However, in combination they 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 repeated arrays of turbines spread across foraging areas and/or flight paths of priority species.

» *Bats*: Cumulative impacts on bats due to multiple wind energy facilities in the region will be of a medium significance if project specific mitigations are implemented for each project.
» *Cumulative geology, soil and erosion potential* - although the impact of soil removal for the proposed activity has a moderate – low significance, the cumulative impact of soil removal in the area is considered low due to undeveloped nature of the area. The cumulative impact of soil pollution in the area is considered moderate. The cumulative impact of siltation and dust in the area is considered low, with the legal obligation of good soil management for each project.
» *Cumulative noise impacts* - the impact of numerous simultaneous construction and operation activities that could affect potential sensitive receptors is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area. The potential for cumulative impacts is low.
» *Infrastructure* - Increased pressure on existing roads and other infrastructure may occur.
» *Heritage* –Cumulative changes to the pre-colonial cultural landscape in terms of visual impacts and changes to 'sense of place' will occur from various projects in the region. The potential for the loss or find of heritage artefacts in the Karoo region will also increase.

10.5 Environmental Sensitivity Mapping and Recommendations

From the specialist investigations undertaken for the proposed Soetwater Wind Farm development site, a number of potentially sensitive areas were identified (refer to **Figure 10.1**) where walk-through surveys are required to be undertaken to confirm the final placement of turbines and other associated infrastructure within these areas (including substation complex, access roads and power line routes). No absolute environmental 'no go' areas were identified on the site. However, the following sensitive areas have identified on the site:

» Habitats and vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 having elevated conservation value and, for that reason, has been classified here as having ecological and avifaunal sensitivity (for this site - important terrestrial habitats that are **south-facing slopes** larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (rated as being of medium sensitivity). Areas classified as mountains, ridges or **steep slopes**: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).
» Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in **natural habitats** within the study area.
» Perennial and non-perennial rivers, streams and **watercourses**. These support the ecosystems in the areas and may provide habitat for priority avifauna species.
» Noise sensitive receptors (farmsteads on / around the site, albeit limited).
» Heritage artefacts (graves, stone walls and old buildings/ruins present on the site). (Note that no infrastructure is proposed on the identified heritage sites).
» Areas of high avifaunal sensitivity include rivers, streams, farm dams and slopes. Based on the results of the pre-construction bird monitoring five wind turbines (6, 20, 31, 28, 33) falls within the high risk areas for avifauna. These turbines should be relocated to areas outside of the high risk areas.
» Areas of high bat sensitivity also include rivers, farm dams and slopes. Two turbines (Turbines 34 and 111) occur in the moderate sensitivity buffer for bats. These turbines must acquire priority during pre/post-construction studies and mitigation measures, if any is needed.

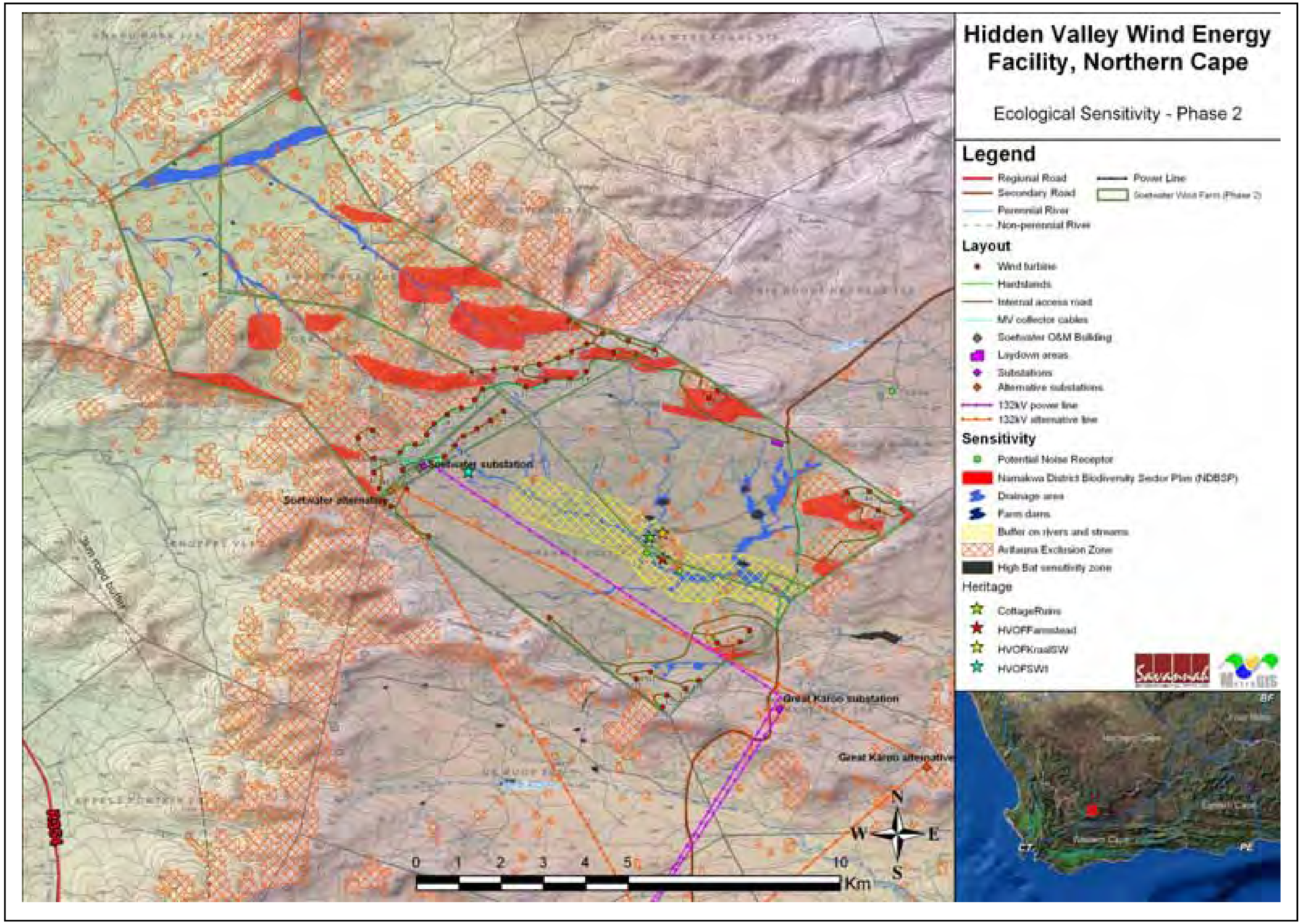

Figure 10.1: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the proposed Soetwater Wind Farm development footprint

Should mitigation measures be adhered to, impacts on the identified sensitive areas can be adequately managed.

10.5.1. Mitigation Strategy

In response to the identified need to adequately manage impacts within sensitive areas identified on the site development footprint, and in order to demonstrate the ability of the project to adhere to recommended mitigation measures, the project developer has developed as a best practice mitigation strategy with regards to the facility layout.

The EIA recommendations have been taken into account by the developer, and the wind turbine layout has been refined to avoid the sensitive areas. This layout considering the required mitigation measures is included in Figure 10.2, and represents the optimal layout for the facility. This refined layout shows a change in the location of the wind turbines.

The table below summarises which wind turbines have been moved out of sensitive areas

Turbine Number - EIA-assessed layout for Phase 2	**Reason for repositioning of turbine**
6, 20, 31, 28, 33	Avifaunal risk – 5 wind turbines placed within a high risk area Action: 5 turbines **repositioned** in the layout
34, 111	Bat risk – 2 wind turbines located within a moderate bat sensitivity buffer area (movement not required but developer adhering to best practice) Action: Although no action was required, the project developer has adhered to best practice and the precautionary principle and therefore 2 turbines **repositioned** in the layout.

Reflected in the revised map (Figure 10.2, a new logical numbering system has been applied to account for the reduction in turbine numbers and distinction between the three phases of the broader project. As is evident from the revised layout and sensitivity map (refer to Figure 10.2) the layout adheres to the mitigation strategy having no wind turbines located in environmentally sensitive areas. Other additional minor movements to turbines to uphold energy generation efficiency were also required in order to accommodate the revision of turbine positions around environmental exclusion zones. This revised layout responding to the mitigation measures was shared with the specialist team, and letters and assessment reports have been obtained (and appended to this amended FEIR) in support of the layout revision. It is confirmed by the specialists that the layout which responds to the mitigation strategy is environmentally acceptable, and either reduces the impacts as originally assessed, or the impact significance ratings remain unchanged.

Letters from specialists confirming the acceptability of the revised layout are attached as Appendix T. The optimised layout is considered to address the significant issues raised through the EIA process, and is supported by the EAP and EIA specialist team for Environmental Authorisation.

Planning of the positioning of infrastructure in this new layout has taken factors into account with respect to existing disturbance on site. Existing road infrastructure will be used as far as possible for providing access to proposed turbine positions. Where no road infrastructure exists, new roads should be placed within existing disturbed areas or environmental conditions must be taken into account to ensure the minimum amount of damage is caused to natural habitats and that the risk of erosion or downslope impacts are not increased. Road infrastructure and underground cable alignments should coincide as much as possible.

The developer must consider the mitigation measures proposed in the heritage impact assessment (Appendix J). Grave and burial areas must be identified and cordoned off before construction and an archaeologist should be appointed to inspect the exact and immediate surrounding area for possible sites once the final positions for the wind turbines and other infrastructure are known. An ECO should also be appointed during the construction phases to observe whether any depth of deposit and in situ archaeological material remains is uncovered. If at any stage during the construction phase any semblance of a fossil is observed, it would be necessary to stop the work immediately and report this occurrence to SAHRA and/or a professional palaeontologist.

The developer should consider the various mitigation options as suggested in the noise EIA assessment (Appendix K) to reduce the significance of the potential noise impact on any sensitive receptors to an impact of lower significance.

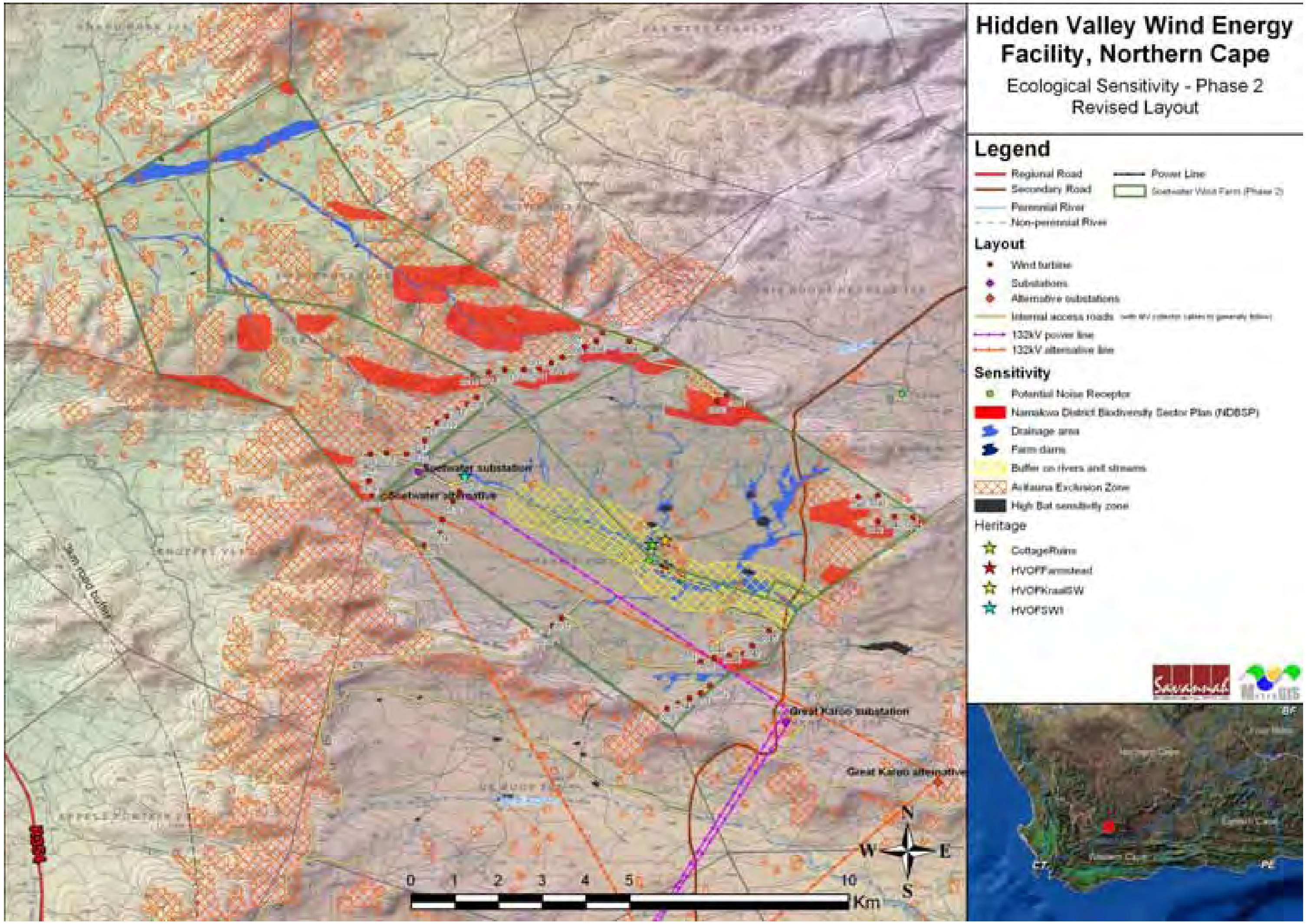

Figure 10.2: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the revised Sooetwater Wind Farm layout for DEA approval

10.6 Overall Conclusion (Impact Statement)

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of resources. In order to meet the long-term goal of a sustainable renewable energy industry in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation capacity being derived from renewable energy forms by 2030.

Through pre-feasibility assessments and research, the viability of establishing the Soetwater Wind Farm, in the Northern Cape has been established by the developer. The positive implications of establishing a wind energy facility on the demarcated site include:

» The project would assist the South African government in reaching their set targets for renewable energy.
» The potential to harness and utilise good coastal wind energy resources on this site would be realised.
» The National electricity grid in the Eastern Cape would benefit from the additional generated power.
» Promotion of clean, renewable energy in South Africa.
» Creation of local employment and business opportunities for the area.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

» There are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
» The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With

reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

10.7. Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the facility and associated substation and power line, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Soetwater Wind Farm and associated infrastructure can and has been mitigated to an acceptable level, provided appropriate mitigation is implemented and adequate regard for the recommendations of this report and the associated specialist studies is taken during the final design of the project.

<u>The revised layout shown in Figure 8.2 is acceptable</u> and the following conditions would be required to be included within an authorisation issued for the project:

- All mitigation measures detailed within this report and the specialist reports contained within Appendices F to M must be implemented.
- The draft Environmental Management Programme (EMPr) as contained within Appendix O of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed wind energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
- Following the final design of the facility, a revised layout must be submitted to DEA for review and approval prior to commencing with construction.
- Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
- A comprehensive search for threatened and near-threatened plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure if known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate

infrastructure, a permit may be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.

» The final location of the wind turbines and associated infrastructure within identified sensitive areas (if any) must be informed by surveys undertaken by ecological and avifaunal specialists. The findings of these surveys must be included in the site-specific EMPr to be compiled for the project.
» Implement an operational phase monitoring programme to record the impact on bat species using the site.
» Implement an operational phase monitoring programme to record the impact on bird species using the site.
» Establish an on-going monitoring programme to detect, quantify and remove any alien plant species that may become established.
» Adequate stormwater management measures to be put in place as the soils on the site may be prone to erosion due to shallow profiles and steep slopes.
» Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads).
» Plan the road and site layout in such a way as to make maximal use of existing roads and fence/border areas to minimise impacts and to keep grazing and natural units as intact as possible.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» Use of fire prevention and fire management strategies for the wind energy facility, to reduce risks to landowners.
» Implement a noise monitoring programme before the development of the wind energy facility. If needs be, quarterly noise monitoring should be conducted by an acoustic consultant for as long as noise complaints are registered.
» Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites (as detailed in the EMPr).
» The heritage artefacts identified in the EIA must be cordoned / protected prior to the start of construction, to ensure that heritage sites are not destroyed.
» Applications for all other relevant and required permits if required to be obtained by the developer or the construction contractor must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to heritage sites, disturbance of protected vegetation, and disturbance to any riparian vegetation or wetlands.

ASSESSMENT OF IMPACTS CHAPTER 11
PHASE 3: GREAT KAROO WIND FARM

Environmental impacts associated with the proposed Great Karoo Wind Farm (Phase 3 of the Hidden Valley project) are expected to be associated with the construction, operation and decommissioning of the facility. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts can be expected to vary significantly from site to site.

The construction for a wind energy facility project include land clearing for site preparation and access/haul roads; transportation of supply materials and fuels; construction of foundations involving excavations and cement pouring; compaction of laydown areas and roadways, manoeuvring and operating cranes for unloading and installation of equipment; laying cabling; and commissioning of new equipment. Decommissioning activities may include removal of the temporary project infrastructure and site rehabilitation. Environmental issues associated with construction and decommissioning activities may include, among others, threats to biodiversity and ecological processes, including habitat alteration and impacts to wildlife through mortality, injury and disturbance; impacts to sites of heritage value; soil erosion; and nuisance noise from the movement of vehicles transporting equipment and materials during construction.

Environmental issues specific to the operation of a wind energy facility may include visual impacts; noise produced by the spinning of rotor blades; avian/bat mortality resulting from collisions with blades and barotrauma; and light and illumination issues.

These and other environmental issues were identified through the scoping evaluation. Potentially significant impacts identified have now been assessed within the EIA phase of the study. The EIA process has involved input from specialist consultants, the project proponent, as well as input from key stakeholders (including government authorities) and interested and affected parties engaged through the public consultation process. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts vary significantly from site to site.

This chapter serves to assess the identified potentially significant environmental impacts associated with the proposed wind turbines and associated infrastructure (substation, power lines, access road/s to the site, internal access roads between turbines, underground and overhead electrical cabling between turbines, turbine foundations), and to make recommendations regarding preferred alternatives for consideration by DEA, as well as for the management of the impacts for inclusion in the draft Environmental Management Programme (refer to **Appendix P**).

In order to assess the impacts associated with the proposed wind energy facility, it is necessary to understand the extent of the affected area. The affected area primarily includes the turbines, substation, overhead power lines and associated access roads. A wind energy facility is dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. The study area for the Great Karoo Wind Farm (approximately 91.8 km^2) is being considered as a larger study area for the construction of this phase of the proposed wind energy facility. The area to be occupied by turbines and associated infrastructure is illustrated **in Figure 11.1** below, and includes the area covered by the following farm portions:

» Farm Kentucky 206
» Portion 1 of Farm Wolvenkop 207

The project will include the following infrastructure:

» Up to 77 **wind turbines**, appropriately spaced to make use of the wind resource on the site. The facility is proposed to have a generating capacity of up to 150 MW, used depending on the final turbine selected for implementation but will be limited to 140MW at the point of connection with the Eskom grid. . The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.
» Each wind turbine is expected to consist of a concrete foundation (20m x 20m), a steel or concrete tower, a hub (between 80m and 120m above ground level, depending on the turbine size decided upon) and three blades with a rotor diameter of up to 120m.
» Cabling between the components, laid approximately 1 m underground where underground cabling feasible. In as far as possible, cabling will follow the internal access roads[23].
» Internal roads (approximately 8 m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines and the vast areas of the site which are not currently accessible will necessitate the construction of ~30 km of new access roads in some areas.

[23] Where underground cabling is not practical or environmentally sensible (e.g. in rocky area where blasting would be required), cabling would be above ground, suspended between ~8m high timber poles at ~60m centres.

» A new 132 kV **substation** is proposed within this phase. The electricity from the 132 kV substation will be transmitted via a 132 kV **power line** to the 400 kV substation complex (located on the Phase 1 site) for connection to the Eskom grid. Two alternative substation locations and power lines are proposed.
» This proposed substation will have a high-voltage (HV) yard footprint of approximately 200m x 200 m.
» **Operations and service building area** for control, maintenance and storage (approximately 2000m^2).
» **Guard house** for access security of 50m^2.

The assessment presented within this chapter of the report is on the basis of a preliminary layout provided by ACED. This layout indicates **77 wind turbines** and associated infrastructure. The assessment of issues presented within this chapter (and within the specialist studies attached within **Appendices F – S**) considers the worst-case scenario in terms of potential impacts. The position of the substation (and the alternative power line) is related to the point of connection to the Eskom grid via the 132 kV substation). The two alternatives for grid connection are as follows and are shown on **Figure 11.1 (a) and (b)**:

» Great Karoo Substation and power line 1 Option 1 is 7 km in length and runs through from Farm 206 and 209 to the 400 kV substation (located on the Karusa site). Option1 is technically preferred.
» Great Karoo Option 2 is 8 km in length and runs through Farm 206, 207 and 209 until it reaches the 400 kV substation complex on Farm 209.

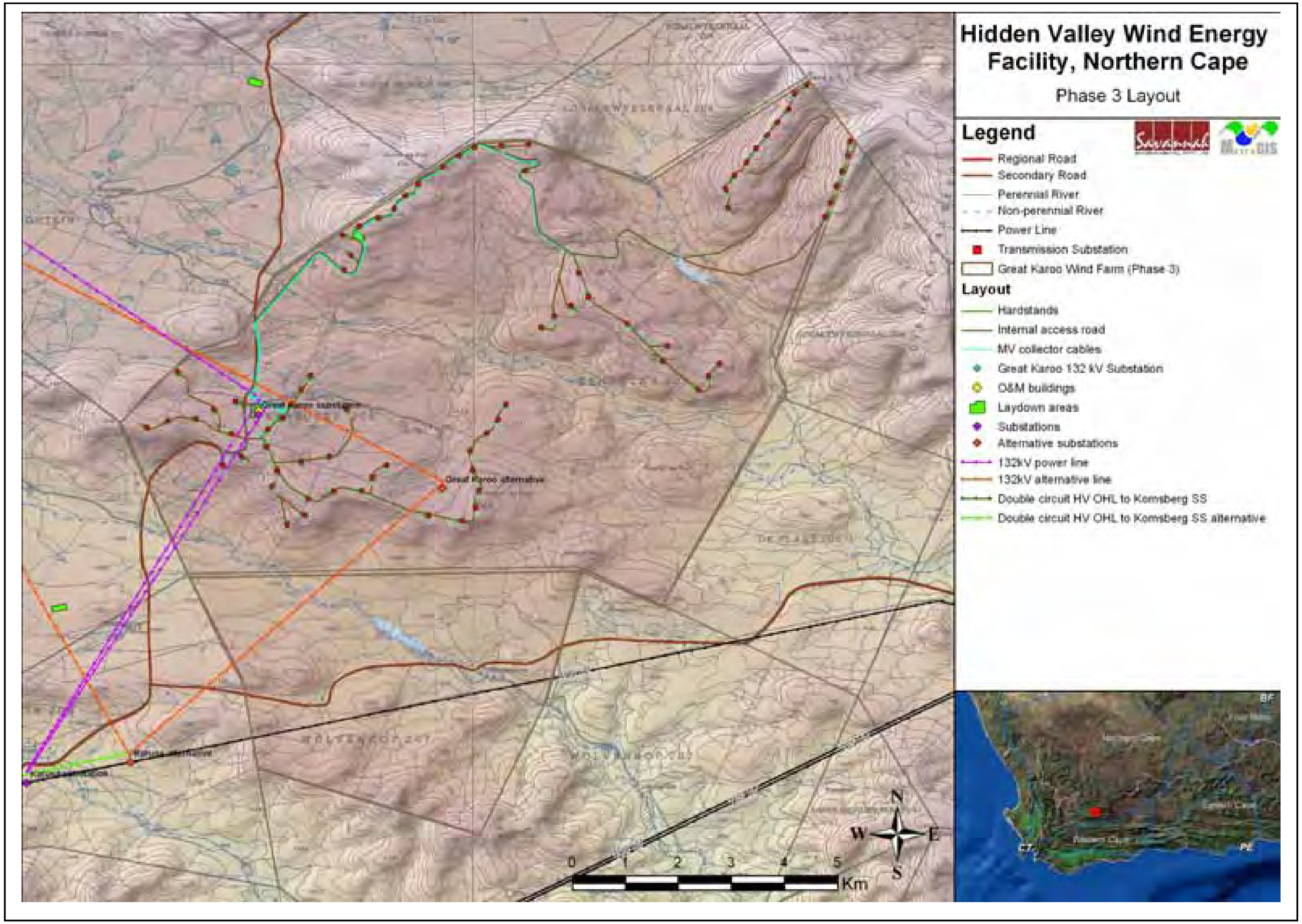

Figure 11.1 (a): Wind Turbine Layout of the Great Karoo Wind Farm (Phase 3)

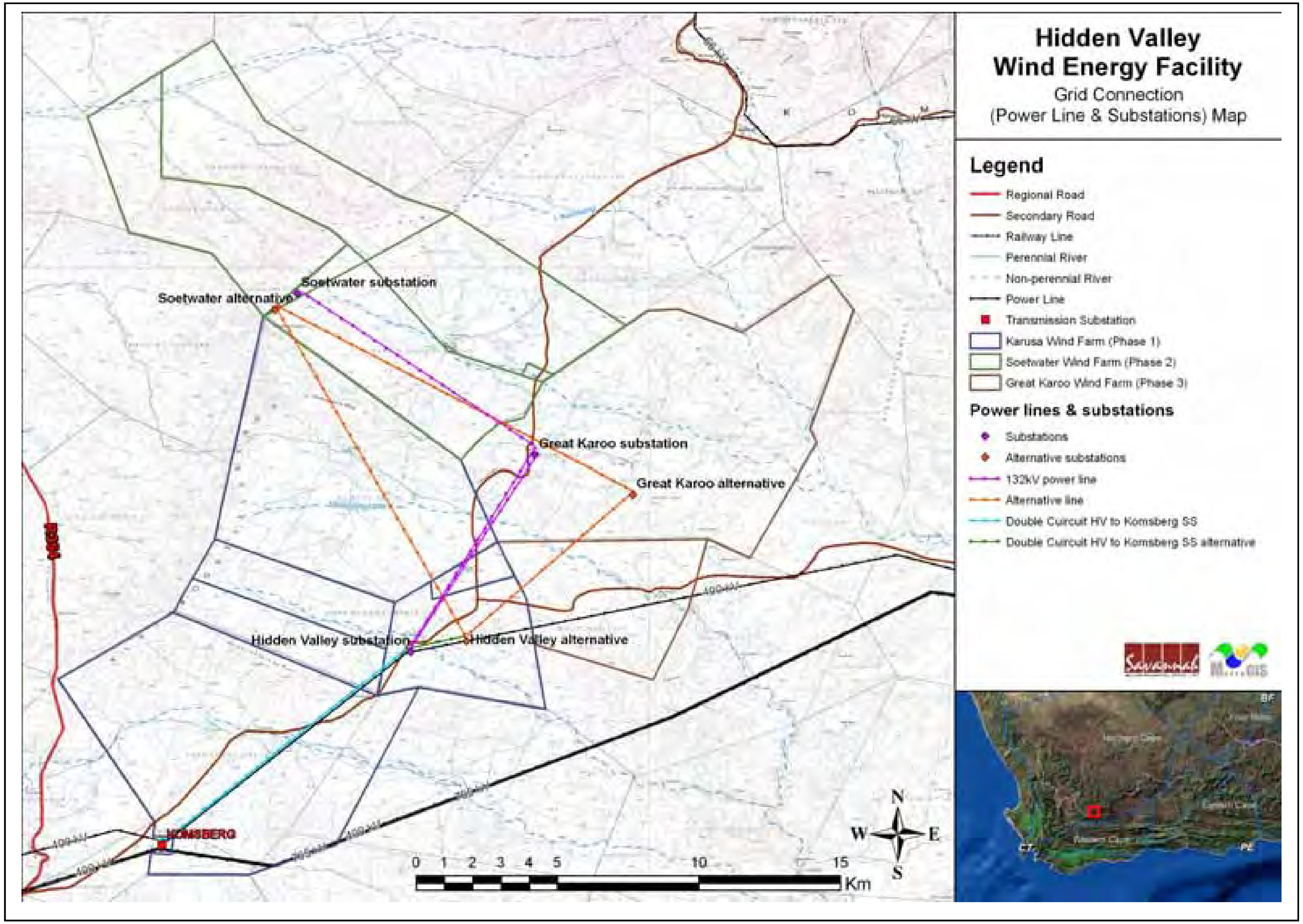

Figure 11.1 (b): Layout of the Great Karoo Wind Farm (Phase 3), indicating the cluster of wind turbines to the northern and western portion of the total extent of the site and the grid connection options.

11.1 Assessment of Potential Impacts on Ecology

The ecological sensitivity assessment identified those parts of the study area that could have high conservation value or areas sensitive to disturbance. Areas of potentially high ecological sensitivity are shown in **Figure 11.2**. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity. A map of remaining natural habitats and areas important for maintaining ecological processes in the study area is shown in **Figure 11.2.** Relatively fine-scale mapping was used to provide information on the location of sensitive features.

Any natural vegetation within which there are features of conservation concern have been classified into one of the high sensitivity classes (medium-high, high or very high). The difference between these three high classes is based on a combination of factors and can be summarised as follows:

7. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
8. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services.
9. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories.

The following areas occur on the site:

- Vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 (for this site - important terrestrial habitats that are south-facing slopes larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (medium sensitivity).
- Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in natural habitats within the study area.
- Perennial and non-perennial rivers, streams and watercourses (high sensitivity).
- Areas classified as mountains, ridges or steep slopes: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).

Figure 11.2 shows the watercourses and drainage lines and steep slopes to have HIGH ecological sensitivity and conservation value. Natural vegetation on site that occurs within the Hantam-Roggeveld Centre of Plant Endemism (HRC) has MEDIUM-HIGH sensitivity, and other natural vegetation has MEDIUM sensitivity.

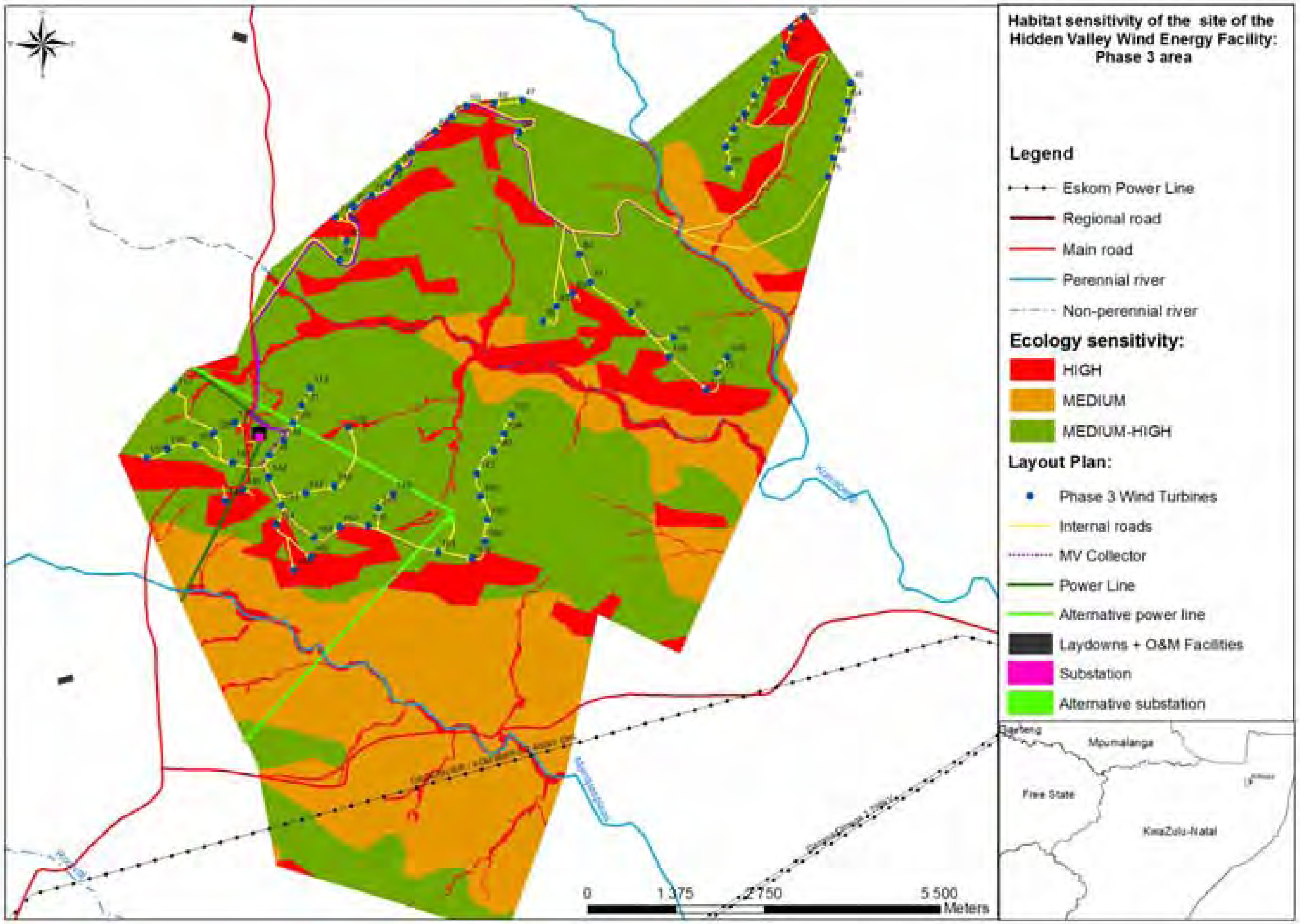

Figure 11.2: Ecological sensitivity map for the Great Karoo Wind Farm (Phase 3), illustrating the location of sensitive vegetation, rivers, wetlands and CBAs

1.1.1 Loss or fragmentation of indigenous natural vegetation

The remaining natural vegetation on site is classified as Least Threatened. However, the site falls within the Cape Floristic Region and the Hantam-Roggeveld Centre of Endemism. It is not expected that turbines structures will have a major effect on natural vegetation, due to the small footprint of each structure, but it is still likely that associated infrastructure such as the access roads will cause negative impacts (disturbance and loss) on natural vegetation.

Construction of infrastructure associated with the proposed wind energy facility may lead to the direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of vegetation. Where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Consequences of the impact occurring may include:

» negative change in conservation status of habitat (Driver et al. 2005);
» increased vulnerability of remaining portions to future disturbance;
» general loss of habitat for sensitive species;
» loss in variation within sensitive habitats due to loss of portions of it;
» general reduction in biodiversity;
» increased fragmentation (depending on location of impact);
» disturbance to processes maintaining biodiversity and ecosystem goods and services; and
» loss of ecosystem goods and services.

Turbines within the preliminary layout are situated within areas with high ecological sensitivity.

11.1.1.1 Impact Table - Impact on indigenous natural vegetation types – wind energy facility and associated infrastructure

Nature: **Loss of habitat within indigenous natural vegetation types**		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	low (4)	Moderate to low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	Yes	
Mitigation: (5) Avoid unnecessary impacts on natural vegetation surrounding the turbines. The construction impacts must be contained to the footprint of the turbine and laydown area. (6) Rehabilitate any disturbed areas immediately to stabilise landscapes. (7) Consider implementing biodiversity offsets, such as stewardship programmes, alien removal or vegetation rehabilitation, to compensate for loss of indigenous natural vegetation.		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact on the site.		
Residual Impacts: Some loss of vegetation will definitely occur.		

11.1.2. Impacts on threatened plants

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, and possibly even local extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

» fragmentation of populations of affected species;
» reduction in area of occupancy of affected species; and
» loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances.

There are five plant species of conservation concern that have a geographic distribution that includes the site and which have a high chance of occurring in the study area. These include:

» three species classified as Vulnerable (*Romulea eburnea, Lotononis venosa and Geissorhiza karooica*) ; and
» two as Rare (*Cleretum lyratifolium and Strumaria karooica*).

The turbines are positioned in areas where these species are most likely to be found. The site is also the core distribution of these threatened species. Turbines are therefore likely to have an impact of medium significance on populations of threatened or rare plant species.

11.1.2.1 Impact Table - Impact on threatened plants

Nature: Impacts on threatened plants		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Local (1)
Duration	Permanent (5)	Long-term (4)
Magnitude	High(8)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (49)**	**medium (33)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: (11) Disturbance of indigenous vegetation must be kept to a minimum, by relocation of wind turbines and associated infrastructure from areas of high ecological sensitivity as far as possible. (12) Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. (13) Prior to construction and once final infrastructure positions are known, the footprint of each turbine must be searched for populations of potentially affected plant species of concern by undertaking a preconstruction survey for the species of concern should be undertaken in the footprint of proposed infrastructure to determine whether any of these species occur within the footprint of turbines or not. Depending on the density of individuals encountered, infrastructure positions to be modified to avoid important populations. If avoiding populations is not possible and any individuals of threatened species will be destroyed, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species. (14) If any populations are found in these areas, move infrastructure to avoid impact. (15) If not possible to relocate infrastructure, a permit is required in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.		
Cumulative impacts: Soil erosion, habitat loss, alien invasions, change in runoff and drainage may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be low if control measures are effectively applied		

11.1.3 Impacts on Wetlands or Watercourses

Construction may lead to some direct or indirect loss of or damage to seasonal marsh wetlands or drainage lines or impacts that affect the catchment of these wetlands. Without mitigation, this could lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

» increased loss of soil;
» loss of or disturbance to indigenous wetland vegetation;
» loss of sensitive wetland habitats;
» loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
» fragmentation of sensitive habitats;
» impairment of wetland function;
» change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
» reduction in water quality in wetlands downstream of road.

Turbines are not located within wetland areas. This potential impact is therefore not relevant to this infrastructure component and is scores as zero significance. Turbines are not located within wetland areas, but internal access roads linking turbines will probably have to cross wetlands in places.

11.1.3.1 Impact Table - Impact on Wetlands/ watercourses

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Short-term (4)
Magnitude	moderate (6)	minor (2)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Irreversible	Reversible to some degree
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Control stormwater and runoff water and inhibit erosion. » Disturbed areas must be rehabilitated as soon as possible. » Align internal access roads so that they branch directly from existing roads and go around wetlands as much as possible. If not possible, then the following measures must also be applied:		

» Obtain a permit from DWA to impact on any wetland or water resource. » Cross watercourses close to existing disturbances. » Cross watercourses perpendicularly, where possible, to minimize the construction footprint. » Adequate culvert and/or bridge structures are required at crossings. » Construction must not cause the width of the watercourse to be narrowed.
Cumulative impacts: Soil erosion, alien invasions, may lead to additional impacts on wetland habitats that will exacerbate this impact.
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

11.1.4. Impacts on threatened animals and associated habitat

Potential negative impacts on populations are only likely for threatened species, which are the Riverine Rabbit and the Armadillo Girdled Lizard. Loss of habitat is the most important negative impact, which will occur primarily during the construction phase of the project. Turbines affect very little natural habitat and are not within areas considered suitable for the Riverine Rabbit. The known distribution of the riverine rabbit does not include the Great Karoo site, as shown in **Figure 11.3.**

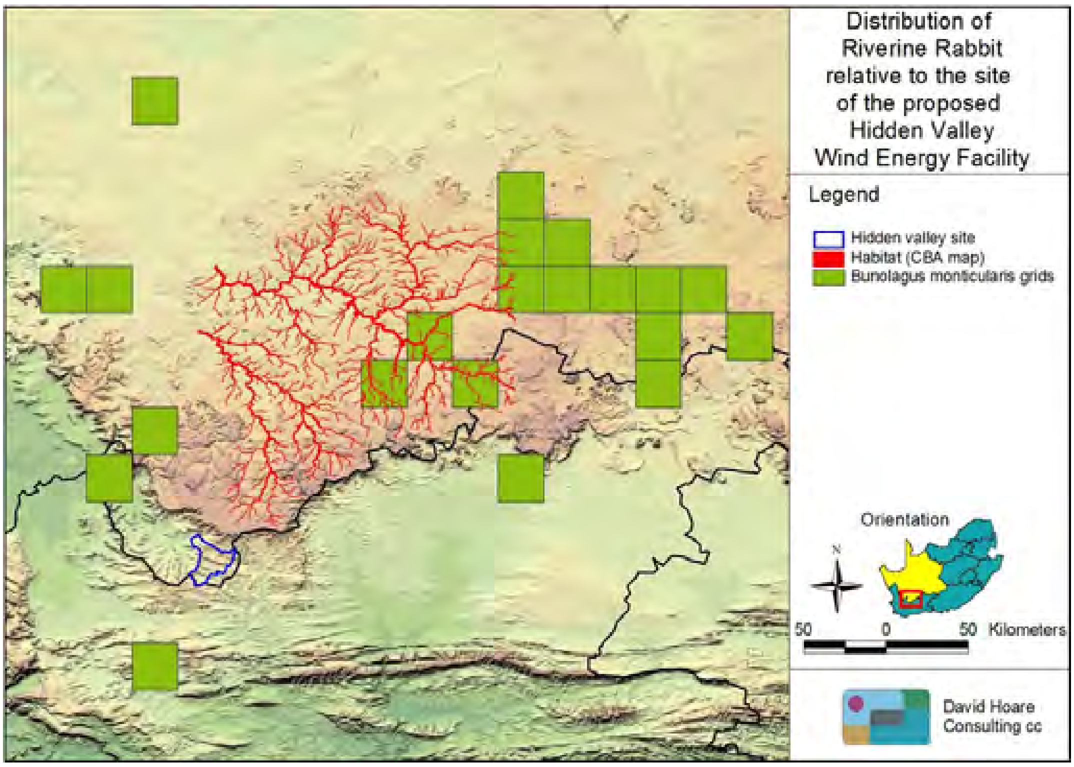

Figure 11.3: Known distribution of the Riverine Rabbit relative to the site.

Threatened animal species are affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species, and possibly even local extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

» fragmentation of populations of affected species;
» reduction in area of occupancy of affected species; and
» loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances. It is improbable that the impact will occur (it is not known whether the species of concern, the Riverine Rabbit and the Armadillo Girdled Lizard, will be affected or not - if they occur it is highly improbable that they will be affected). Based on the proposed position of turbines, no highly suitable habitat will be affected.

11.1.4.1 Impact Table - Impact on threatened animals / habitat

Nature: Impacts on individuals of threatened animal species		
	Without mitigation	**With mitigation**
Extent	local (3)	local (3)
Duration	permanent (5)	permanent (5)
Magnitude	low (4)	low (4)
Probability	Highly improbable (1)	improbable (2)
Significance	**low (12)**	**low (12)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	yes	
Mitigation: (5) Undertake a walk-through survey of areas with sandy soils once final infrastructure positions are known. (6) If any threatened animal populations are found in these areas, move infrastructure to avoid impact as far as possible.		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions) may exacerbate this impact.		

Residual Impacts:
Unlikely to be residual impacts.

11.1.5. Establishment of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes high disturbance. Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

- loss of indigenous vegetation;
- change in vegetation structure leading to change in various habitat characteristics;
- change in plant species composition;
- change in soil chemical properties;
- loss of sensitive habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- change in flammability of vegetation, depending on alien species;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of wetland function.

There are very few concentrations of alien plants on site and habitat is in a natural state. Turbines will create areas of disturbance that will provide conditions in which alien plants are more likely to spread and thrive. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will enhanced by construction of turbines on site. A checklist of species previously recorded in the grid in which the site is located indicates that the following species are likely to invade the site, given the right conditions the following (*Salsola kali, Atriplex lindleyi, Opuntia ficus-indica, Opuntia imbricata, Prosopis glandulosa, Prosopis velutina, Atriplex numularia, and Nicotiana glauca).* The invasion of watercourses by alien plants is noted as a biodiversity issue of particular concern in the Namakwa District Biodiversity Sector Plan.

The wind turbine, substation, access roads and other infrastructure will create new nodes of disturbance within an otherwise undisturbed landscape. It is therefore expected that conditions favouring the establishment and spread of alien invasive plants will be enhanced.

11.1.6.1 Impact Table - Alien vegetation growth due to disturbance

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	long-term (4)
Magnitude	moderate (6)	Minor (2)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: » Keep disturbance of indigenous vegetation to a minimum. » Rehabilitate disturbed areas as quickly as possible » Do not translocate soil stockpiles from areas with alien plants » Control any alien plants, especially within wetlands and watercourses » establish an on-going monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

11.1.6. Vegetation and habitat Loss due to Access Roads

The development of access roads to the site and to each wind turbine has the potential to cause negative impacts on ecology. Access roads will entail clearing of vegetation, therefore vegetation loss and habitat loss for plant species. Creation of access roads causes nodes of disturbance, and may become hotpots for soil erosion. This impact could occur on the site, and presents a risk particularly on steep slopes and hills, where turbines are proposed. Some access roads may inevitably cross drainage lines, which may cause downstream effects on watercourse, cumulatively. Therefore the impact of access roads, without environmental control measures may be of a moderate significance and with mitigation this impact could be manageable.

9.1.6.1 Impact Table – Impact of access roads on ecology

Nature: Loss of habitat within indigenous natural vegetation types, disturbance and soil erosion due to creation of permanent access roads.		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	Permanent (5)	permanent (5)
Magnitude	moderate (6)	Moderate (5)
Probability	definite (5)	probable (3)
Significance	**medium (60)**	**medium (33)**
Status (positive or negative)	negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » Internal access roads must make use of existing roads on site, as far as possible. Where new roads are to be constructed, these should follow existing tracks or disturbed areas or the edges of disturbed areas » Avoid unnecessary impacts on natural vegetation surrounding the turbines. The construction impacts must be contained to the footprint of the turbine and laydown area. » Disturbed areas must be rehabilitated as quickly as possible		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of natural vegetation type is likely to occur, but only a small extent is potentially at risk.		

11.1.7. Comparative Assessment of Grid Connection Options

Note that the Great Karoo power lines connect via Phase 1 (Karusa) power lines and into Komsberg substation. Both grid connection options traverse the "Meintjiesplaas" non-perennial stream Portion 1 of Farm Wolvenkop 207 However, due to the power line being able to span a drainage line, as well as the servitude (width of a 132kV servitude being ~36m) being a right of way only, this is not considered to be a major issue. Both powerline and substation options occurs in areas of medium ecological sensitivity. Therefore both grid connection options will have a similar impact on the ecological environment. With the use of mitigation measures during construction, both grid connection options are acceptable, with no preference from an ecological perspective.

11.1.8. Cumulative impacts

To some extent a cumulative impact is a regional impact, rather than the local site scale impact, i.e. if something has a regional impact it also has a cumulative impact. Cumulative impacts for this assessment will include any approved wind energy facilities in the area. The cumulative impact of the Great Karoo Wind Farm has been considered two levels:

» Firstly, impacts of the Great Karoo Wind Farm plus the other two development phases of the Hidden Valley project (i.e. Phase 1 and Phase 3).
» Secondly, the additive impact of this project and other approved wind projects within a 10 – 20 km radius of the site. Based on the information available at the time of undertaking this EIA, four wind energy facilities have environmental authorisations and occur in close proximity to the Hidden Valley site.

Wind Farm (Developer)	**No. of turbines**	**Distance (km)**	**Status of the development**	**DEA Reference Number**
21. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Roggeveld	Authorisation received	12/12/20/1783
22. Witberg Wind Farm (G7 Renewable Energies)	Up to 27	Approx. 25km south of Roggeveld	Authorisation received	12/12/20/1966
23. Sutherland (wind and solar) (Mainstream SA)	293 to 386	Approx 35km north east o/f Roggeveld	Authorisation received	12/12/20/1782
24. Suurplaat Wind Farm (Moyeng Energy)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received	12/12/20/1583
25. Roggeveld Wind Farm (G7 Renewable Energies)	Approximately 207	Adjacent to the Hidden Valley site (to the west)	EIA in process	12/12/20/1988/1-3
26. Gunstfontein (wind and solar) Networx Eloes	Approximately 100	Adjacent to the Hidden Valley site (to the north)	EIA in process	14/12 /16/3/3/2/399 (wind) 14/12/16/3/3/2/395 (solar)

Cumulative ecological impacts are expected to be of a moderate significance and include cumulative loss of biodiversity (particularly for protected plants and animal species and soil erosion), and can be effectively mitigated through sound environmental management (mitigation measures) during construction and operation covered in the EMPr and by formal conservation and active management of the natural areas on site. With the implementation of this mitigation, cumulative impacts on ecology as a result of the establishment of various wind energy facilities in the area could be of an acceptable level.

Cumulative effects are however highly uncertain due to the complexities of wind farm development and the likelihood that not all planned wind farms in the area will ultimately be constructed.

11.1.9. Conclusions and Recommendations

The overall impacts of this proposed project are of low or moderate significance in most cases, but of potentially high significance on populations of threatened plant species due to the proposed location of selected turbines in areas of potentially high sensitivity. With mitigation measures implemented, it should be possible to reduce all negative impacts to low significance, except on populations of threatened plants and on natural vegetation, where the impact is likely to remain of medium significance. Potential impacts on vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2, habitat for threatened plants and animals, wetlands / water courses and non-perennial rivers occur on the site, particularly in areas of High sensitivity which are indicated in **Figure 11.3**. These are not necessarily “no-go” areas, but areas of high ecological sensitivity. If impacts on threatened and protected species are managed, it should be possible to develop within these areas of high sensitivity. However, it is recommended that wetlands / watercourses should be avoided as far as possible.

The following pertinent recommendations are made:

» A comprehensive search for threatened and near-threatened plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure is known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate infrastructure, a permit may be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.
» Consider implementing biodiversity offsets, such as stewardship programmes, alien removal or vegetation rehabilitation, to compensate for loss of indigenous vegetation.
» Establish an on-going monitoring programme to detect and quantify any alien plant species that may become established as a result of disturbance.
» Implement mitigation measures as stipulated in the EMPr

» Appoint an ECO during construction.

11.2 Assessment of Potential Impacts on Avifauna

The findings of the pre-construction bird monitoring programme have been incorporated into this section, supplementary to the avifaunal impact assessment (EWT, February 2012).

The effects of a wind energy facility on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss causes a reduction in birds using an area which might then reduce the risk of collision). The principal areas of concern are:

» Bird Mortality due to collision with the wind turbines.
» Displacement due to disturbance and Habitat loss due to the footprint of the wind farm.
» Bird mortalities from collisions with the associated power lines.
» Electrocution of birds by power lines.

Based on the pre-construction bird monitoring programme, sixteen (16) priority bird species were identified on the site including:

» African Harrier-hawk
» Amur Falcon
» Black-shouldered Kite
» Blue Crane
» Booted Eagle
» Gabar Goshawk
» Jackal Buzzard
» Lanner Falcon
» Ludwig's Bustard
» Martial Eagle
» Rock Kestrel
» S. Pale Chanting Goshawk
» Southern Black Korhaan
» Steppe Buzzard
» Verreauxs' Eagle
» Yellow-billed Kite

The Avifaunal Impact Assessment study (EWT 2012) presented avian sensitivity maps, which were generated using site visit information, aerial imagery, and vegetation, and avifaunal habitat mapping. This information was used to determine the avian risk maps developed for the pre-construction bird monitoring report. The EWT recommended exclusion zones for Hidden Valley site and the original turbine layout is shown in Figure 11.4.

The sensitivity categories were assigned using the following factors:

» High sensitivity: The high sensitivity zones include the Rivers and Streams in the study area buffered by 150m on either side, ridge buffers were not included on the map as flight data was used instead. These zones represent potential high sensitivity areas. These areas should be considered in the final layout of the facility and when positioning the wind turbines. However, it is strongly recommended that current turbine positions within these zones be moved, especially those along ridge edges, which should be moved 100m (or more) back from the ridge edge. Associated infrastructure, including roads, power lines and buildings, should avoid these zones. The confidence with which these “High sensitive” areas were identified was medium, and the extent of these zones are indicated in the flight models below with high likelihood ratings.
» Medium Sensitivity: The medium sensitivity zones identified are farm dams as well as certain low risk ridges. These dams and ridges were primarily identified at a desk top level while the presence of a few were confirmed during the site visit as being potentially important to avifauna. However construction of infrastructure may be possible, with caution, in these areas with medium likelihood.
» Low Sensitivity: These are the remaining areas with little likelihood. No obvious avifaunal features or patterns could be identified during the study. However some areas could be designated as Medium in the future upon availability of new data and/or after additional site analysis or pre-construction monitoring. At this there is no proven reason that infrastructure should not be built in these areas. Therefore, these Low sensitivity areas are preferred for construction, particularly of early phases.

Based on the results of the pre-construction bird monitoring four (4) wind turbines from the original layout (75, 76, 149 and 154) falls within the high risk areas for avifauna. These turbines should be relocated to areas outside of the high risk areas as shown in Figure 11.4 and as informed by the pre-construction bird monitoring study. The applicant has thus adhered to the recommendations made by the avifaunal specialists and no turbines are placed within high risk areas. This is shown in discussed in more detail in the conclusions chapter 12.

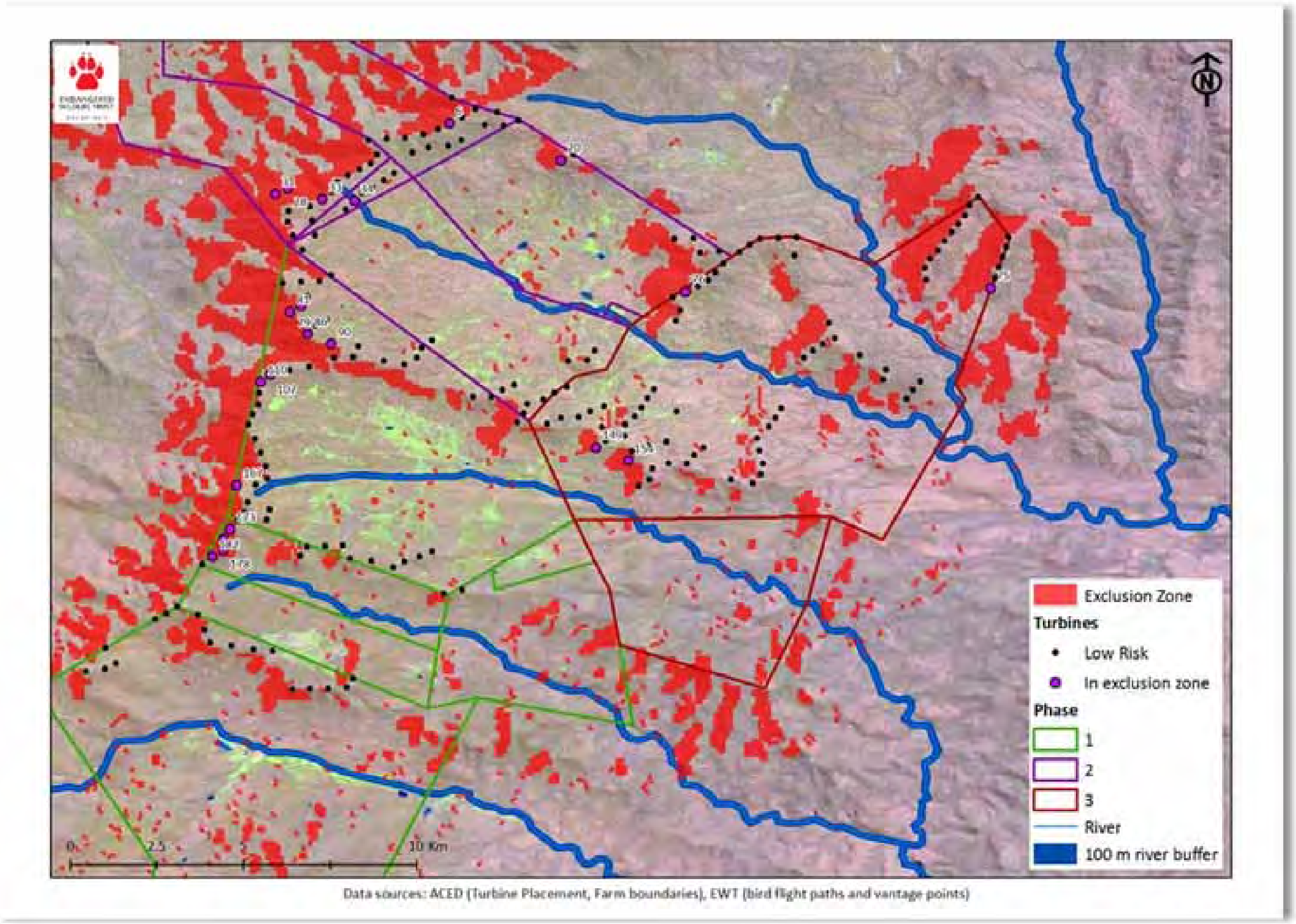

Figure 11.4: EWT recommended exclusion zones for Hidden Valley site and the original turbine layout

11.2.1 Bird Mortalities due to collisions with wind turbines

The three main hypotheses proposed for birds not seeing turbine blades are as follows (Hodos, 2002):

» An inability to divide attention between prey and obstacles. This seems an unlikely explanation as birds have been found to maintain good acuity in the peripheral vision, have different foveal region in the eye for frontal and ground vision and they have various other optical methods for keeping objects at different distances simultaneously in focus.
» The phenomenon of motion smear or retinal blur.
» The angle of approach. If a bird approaches from side on to the turbine, the blades present a very small profile and are even more difficult to detect.

The findings of the pre-construction monitoring support the impacts assessment and significance ratings as provided in the avifaunal impact assessment report (EWT, 2012), which are presented below.

11.2.1.1 Impact Table - Bird Mortalities due to collisions with wind turbines

Nature of the Impact: Collision of birds with turbines at Great Karoo Wind Farm.		
	Without Mitigation	**With Mitigation**
Extent	Site- Impact will occur locally, but have national implications for certain species (2)	Site- Impact will occur locally, but have national implications for certain species (2)
Duration	Long term (4)	Long term(4)
Magnitude	Very high (10)	Very high (10)
Probability	Probable (3)	Probable (3)
Significance	**Medium (48)**	**48 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Partially	
Mitigation » The most important mitigation option is the correct positioning of turbines outside of the identified high sensitivity zones, and where possible, outside of the medium sensitivity zones. » A post-construction monitoring program will be vital to determine additional mitigation measures or the behavior of the bird species. » Additional available or potential mitigation options therefore would need to be employed		

once the turbines are already operational, if monitoring reveals significant impacts. Some mitigation options that can be employed if monitoring reveals significant numbers of collisions, include: that one blade be painted black, in order to provide an alternating image for the bird in flight; curtailment, i.e. shutting down certain turbines at certain times; manipulation of blade height to accommodate predominant bird flight height, and any others that may be identified as our understanding of the impacts progresses.
Cumulative impacts The cumulative impact of bird collisions in the may be significant if mitigation measures are not followed. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with overhead cables in the area. If other proposed wind projects in the broader area are built, they may further impact on these target species' populations. An additional mortality factor such as collision with turbines may prove detrimental to local populations of these species
Residual impacts None

11.2.2 Displacement of Birds due to Disturbance and habitat loss

During the construction phase habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, through the modification of habitat. During the construction and maintenance of electrical infrastructure, a certain amount of disturbance also results. For shy, sensitive species this can impact on their usual daily activities, particularly whilst breeding.

11.2.2.1 Impact Table - Impact on birds due to disturbance

Nature of the Impact: Disturbance and habitat loss of birds during construction of Great Karoo Wind Farm		
	Without Mitigation	**With Mitigation**
Extent	Local – site & immediate surrounds only (2)	Local – site & immediate surrounds only (2)
Duration	short term (2)	short term (2)
Magnitude	moderate (6)	Moderate (6)
Probability	highly probable(4)	Probable (3)
Significance	**Medium (40)**	**Medium (30)**
Status (positive or negative)	Negative	Negative

Reversibility	Medium	High
Irreplaceable loss of Resources?	No	No
Can impacts be mitigated?	Partially	

Mitigation

» Strict control should be maintained over all activities during construction, in particular heavy machinery and vehicle movements, and staff.

» Sensitive zones described elsewhere in this report, should be avoided where possible. It is difficult to mitigate properly for this as some disturbance is inevitable as a result of the use of equipment and heavy vehicles.

» Environmental measures will be detailed in the site specific EMP and will be enforced and overseen by the ECO for the project.

» During the construction phase a site walkthrough is recommended so that the avifaunal specialist can identify any breeding sensitive bird species in close proximity to specified turbines and associated infrastructure positions. If any of the "Focal Species" identified in this report are observed to be roosting and/or breeding in the vicinity, the EWT is to be contacted for further instruction. It is recommended that a ridge survey is undertaken for the identification of nesting sites before construction.

Cumulative impacts

Low

Residual impacts

Low

11.2.4 Collision / Electrocution of Birds by Power line

The proposed power lines options that will link the wind facility to the grid could pose a collision risk. Because of their length and prominence, power lines constitute an important interface between birds and people.

» ***Collision:*** Collisions of birds with a power line are a threat to birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the result that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

» ***Electrocution of birds by power line:*** This scenario occurs when a bird is perched or attempts to perch on the electrical structure (such as a power line) and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution is possible on 132kV lines or lower. The electrocution risk of the associated overhead power lines can only be assessed once the tower structure to be used is known. Species that could be impacted upon include herons, storks, and some large eagles.

11.2.4.1 Impact Tables – Electrocution of birds with the Power line

Nature of the Impact: Electrocution of birds on associated overhead power lines at Great Karoo Wind Farm.		
	Without Mitigation	**With Mitigation**
Extent	Site- Impact will occur locally, but have national implications for certain species (2)	Site- Impact will occur locally, but have national implications for certain species (2)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Very high (10)
Probability	Probable (3(	Very improbable (1)
Significance	**Medium (48)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation Associated power-lines should be placed underground where possible. Any overhead power lines which are built, and which are above ground and are 132kV or lower, should use a “bird friendly” monopole structure, fitted with a bird perch, as per Eskom standard guidelines.		
Cumulative impacts The power line network in the study area is a source of unnatural mortality for large terrestrial species, specifically Blue Cranes and Denham’s Bustard. This power line will further increase the cumulative risk posed by the network.		
Residual impacts Low		

11.2.4.2 Impact Tables – Collision of birds with the Power line

Nature of the Impact: Collision of birds with associated overhead power lines at Great Karoo Wind Farm		
	Without Mitigation	**With Mitigation**
Extent	Site- Impact will occur locally, but have national implications for certain species 2	2 (Site- Impact will occur locally, but have national implications for certain species)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Very high (10))
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Medium (32)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of Resources?	Yes	Yes
Can impacts be mitigated?	Partially	
Mitigation Distribution power lines connecting turbines should be placed underground where it is feasible to do so. Mark relevant sections of line (i.e. within the Medium-High Sensitivity zones) with appropriate marking devices. The exact spans will be finalised as part of the EMPr phase (during micrositing/site walkthrough), once power line routes are finalised and pylon positions are pegged.		
Cumulative impacts The cumulative impact of bird collisions in the area is may be significant. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with overhead cables in the area. If additional power lines in the broader are built, they may further impact on these target species' populations.		
Residual impacts Undetermined		

11.2.5Comparative Assessment of Grid Connection Options

The power line alternatives in relation to the avifaunal sensitivity map are shown in Figure 11.5. The Great Karoo Power line Option 1 is 7 km in length and connects the Great Karoo Substation Option 1. The Great Karoo power line Option 2 is 8 km in length and connects to the Great Karoo substation Option 2. Of the 2 grid connection options, Option 1 (substation and power line) is slightly preferred, as the power line for Option 2 goes across farm small farm dams (which have been buffered due to bird habitat). Both options are not ideal, and it appears that the power line merely attempt to take the shortest, direct route. It is recommended that the lines follow existing fence-lines, roads and farm roads where possible or adhere to exclusions and buffer zones where possible. Mitigation is recommended in this report as followed, i.e. collision mitigation, in the form of "bird flight diverters" fitted to the required sections of line, must be identified through a site "walkthrough" prior to construction to position power line towers. .

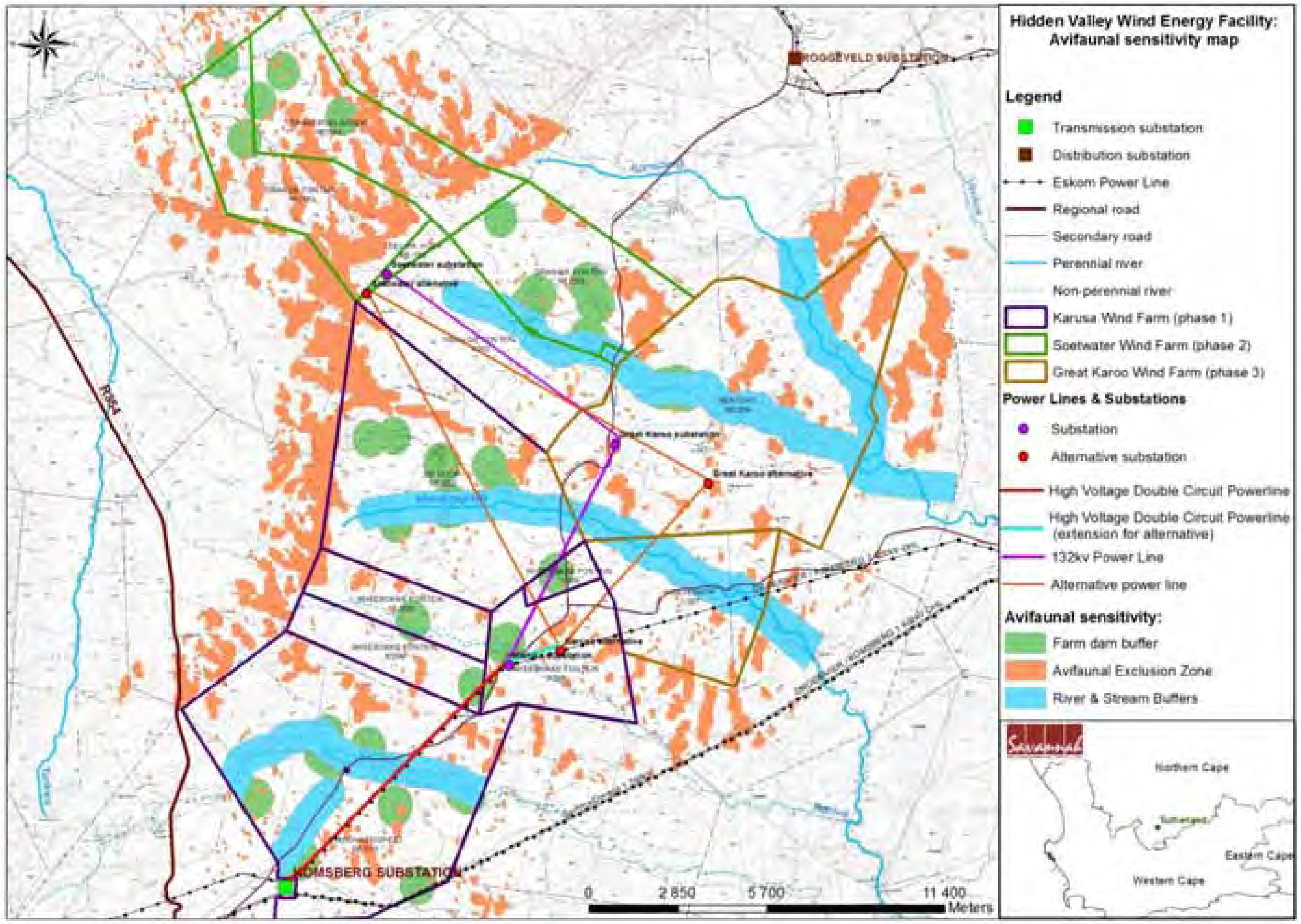

Figure 11.5: Grid Connection Options for Phase 3 (also shown in other Phases) overlain with avifaunal sensitive areas

11.2.6. Cumulative impacts

The cumulative impact of the Great Karoo Wind Farm has been considered at two levels:

» Firstly, impacts of the Great Karoo Wind Farm plus the other two development phases of the Hidden Valley project (i.e. Phase 1 – Karusa Wind Farm and Phase 2 – Soetwater Wind Farm). The three –phased development of the Hidden valley project could have cumulative effects facilities on bird species of conservation concern may be moderate to high, without mitigation. However, with mitigation, the cumulative effects will be of acceptable levels.
» Secondly, the additive impact of this project and other approved wind projects within a 10 – 20 km radius of the site. It is impossible to say at this stage what the cumulative impact of all the proposed wind developments in this region of the Northern Cape will have on birds, firstly because there is no baseline to measure it against, and secondly because the extent of actual impacts will only become known once a commercial wind energy facility is developed in South Africa / the Northern Cape. Based on the information available at the time of undertaking this EIA, four wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site ..

The cumulative effect of the four or more wind energy facilities, within a 10-20 km radius of each other on bird species of conservation concern may be of moderate significance. It is therefore imperative that pre-construction and post-construction monitoring is implemented any accepted / endorsed bird monitoring guidelines / standards to provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. This will provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. At this stage, indications are that displacement may emerge as a significant impact, particularly for the target species such as Ludwig's Bustard Black Stork, Southern Black Korhaan, Martial Eagle, Jackal Buzzard, Greater Flamingo, Lesser Kestrel and assorted waterfowl, and waders. In some cases, these species serve as surrogates for other similar species, examples being Lesser Kestrel for Rock Kestrel, and Southern Black Korhaan or Karoo Korhaan.

The cumulative effect of surrounding wind energy facilities with the proposed Hidden Valley wind energy facility will increase the significance of the following impacts:

» Collision with turbines
» Impacts with overhead power lines

» Disruption in local bird movement patterns

The impact tables below are based on the assumption that 50% of the applications for the surrounding farm areas will be approved / have been approved (based on public information regarding existing applications).

Nature: Cumulative avian collision with turbines		
	Without mitigation	**With mitigation**
Extent	Medium (2)	Medium (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	High(8)	High(8)
Probability	Probable (3)	Probable (3)
Significance	**Medium (39)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	limited	

Nature: Cumulative Impacts with overhead power lines		
	Without mitigation	**With mitigation**
Extent	High (3)	Medium (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	High(8)	Moderate (6)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (56)**	**Low (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	limited	

Nature: Disruption in local bird movement patterns		
	Without mitigation	**With mitigation**
Extent	High (3)	High (3)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (48)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	no	no
Can impacts be mitigated?	No	

The cumulative impact of bird collisions in the area may be moderately significant should the wind farms ever be developed. Many of the target species for this study are species that are potentially already significantly impacted upon by collisions/electrocutions with any existing overhead cables in the area as a result of their flight patterns and physical characteristics. If other proposed wind projects in the broader area are built, they may further impact on these target species' populations. An additional mortality factor such as collision with turbines may prove detrimental to local populations of these species. Additional wind energy facilities will increase the overall distance and spans of overhead lines in the area to connect with the nearest sub-station.

Cumulative effects are however highly uncertain due to the complexities of wind farm development and the likelihood that not all planned wind farms in the area will ultimately be constructed. Furthermore, with the appropriate pre- and post-construction monitoring potential impacts can be mitigated through correct turbine and overhead line placement as well as overhead line flappers and alike.

11.2.7. Conclusions and Recommendations – Avifauna

_Collision with the turbine blades is likely to be the most significant impact, to which all of the focal species are vulnerable. With a project of this size, habitat destruction may also be significant.

» The proposed site was found to be moderately sensitive in terms of avifauna, with areas of high, medium and unknown sensitivity being present on site and a large number of sightings of priority birds specifically soaring species utilizing the topography on site.
» There are no fatal flaws associated with the site, and the project should proceed subject to the moving of turbines out of high risk areas to areas of lower risk as identified in the pre-construction bird monitoring report.
» This site has less steep and lower ridges/hills, and therefore has fewer turbines in areas of high sensitivities.
» Based on the results of the pre-construction bird monitoring (4) wind turbines of the original layout (75, 76, 149 and 154,) falls within the high risk areas for avifauna. These turbines have been relocated to areas outside of the high risk areas as presented in the conclusions chapter (Chapter 12) as informed by the pre-construction bird monitoring study.
» It is recommended that the power – line routes follow existing roads and servitudes and avoid the buffer zones identified.
» An avifaunal "walkthrough" or "micro-siting" site visit is recommended for power-line alignment and for position of masts.

- In terms of the “no-go” alternative, the current status quo would be maintained by not implementing the proposed wind farms. The current farming activities will continue and the land use will not change. Presence and abundance of bird species, as described in the Avifaunal EIA Report, would remain the same. Purely in terms of impacts on avifauna, this option would have the least impacts.
- In terms of the substation and power line layout alternatives, substation and power line Option 1 is preferred.
- As per the best practice guidelines, post-construction should be undertaken to compare the data before and after the presence of operational turbines. It is recommended that the power line routes follow existing roads and servitudes and avoid the buffer zones identified as far as possible. An avifaunal “walkthrough” or “micro-siting” site visit is always recommended for power-line alignment and for position of masts.
- The EMPr contains a draft operational phase bird monitoring programme.

11.3 Impacts on Bats

11.3.1 Results of the Pre-Construction Bat Monitoring Programme

In order to characterise the bat community (baseline) a pre-construction bat monitoring programme was undertaken at the Hidden Valley Wind Energy Facility site and at a control site by Animalia cc. The bat monitoring report also contains an assessment of the potential impacts of the wind energy facility on bats. The pre-construction bat monitoring and assessment report is attached to Appendix S. The results of the pre-construction bat monitoring to date confirmed that there are three bat species (one specie considered as “near threatened” (the Natal long-fingered bat) and two considered as species of “least concern (the Cape Serotine bat and the Egyptian Free-tailed bat) which occurred at the proposed Hidden Valley wind energy facility site. The bat monitoring study found that high localised bat activity at certain times of the year occurred on the wind energy facility site although not in close proximity to any planned turbine positions.

Figure 11.6 depicts the bat sensitive areas of the Great Karroo site, based on features identified to be important for foraging and roosting of the species that are confirmed and most probable to occur on site. This map has been used to inform the pre-construction mitigation and planning in terms of improving turbine placement in relation to preferred habitats bat on the site.

In terms of the bat sensitivity map, the following categories have been used:

- Moderate Sensitivity: Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology, with an expected relative higher risk of impacting on local bats. Turbines within or close to these areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and mitigation measures, if any is needed.
- High Sensitivity and their buffers: Areas that are deemed critical for resident bat populations, capable of elevated levels of bat activity and support greater bat diversity than the rest of the site. These areas are 'no-go' areas and turbines must not be placed in these areas.

The following is relevant regarding turbines in relation to the bat sensitivity map:

- Based on the current layout for the Great Karoo phase no turbines occur in the areas of high sensitivity or in the high sensitivity buffer.
- No turbines occur in the moderate sensitivity area.
- One turbine (125) occurs in the moderate sensitivity buffer.
- Turbines 151, 154, 157, 162 occur immediately outside of moderate bat sensitivity buffer.

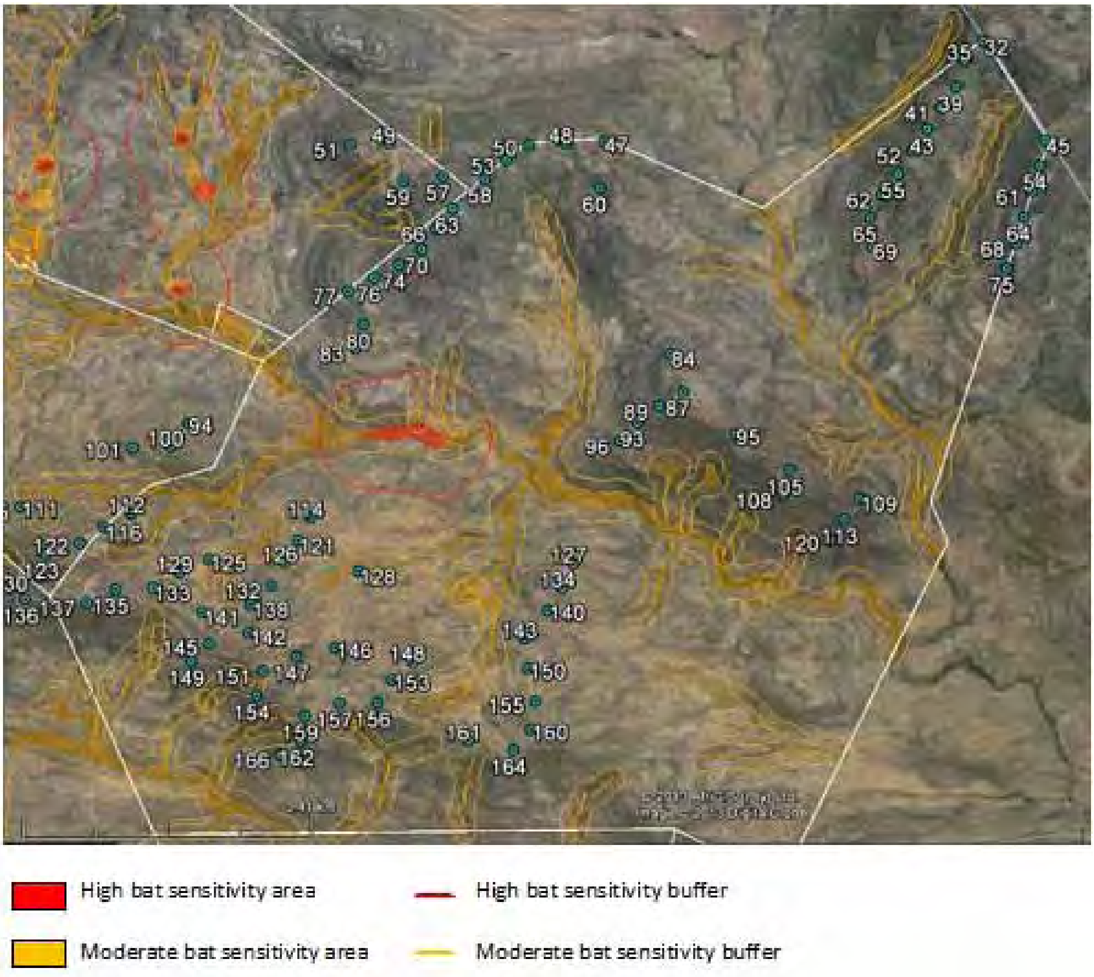

Figure 11.6: Sensitivity map of the proposed Great Karoo wind farm

No proposed turbines are located in areas of high bat sensitivity or their buffers in this phase, but rather on the higher surrounding hills. SM6 showed overall the highest bat activity of all systems but is located in a valley area and not in an area similar to where turbines are proposed. This system serves as a control against the other systems (over all three phases) that are located in terrain similar to where turbines are proposed. It is therefore clear from the data gathered and by comparing the control against other systems, that the lower lying areas have higher bat activity than the raised areas where turbines are proposed. No movements of turbines are therefore required. The impact of the wind turbines for the Great Karoo Wind Farm on bats is expected to be low significance if layout revisions adhere to the sensitivity map areas. Due to the low bat activity recorded by passive systems on this phase in comparison to the control systems, confidence in the impact statement is high.

11.3.2 Impact Tables summarising impacts on bats

Wind turbines can cause bat mortalities due to collision of bats with the wind turbine blades, however more often due to barotrauma. Barotrauma refers to bat deaths due to tissue damage to air- containing structures caused by rapid or excessive pressure change close to the rotating wind turbine blades surface. Death is usually caused by pulmonary barotrauma where lungs are damaged due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald et al., 2008). The potential collision risk is not the same for all bat species and it varies according to the species' habits and ecology. Construction may result in habitat loss of based, which is also assessed in the tables below.

Nature: Bat mortalities due to direct blade impact or barotrauma during foraging (not migration) Turbines on this phase are positioned in between bat sensitivity areas and more spread out over the phase than with the other 2 phases. Furthermore these turbine positions are on high rise areas where bat activity is typically lower. Bats are expected to mostly forage in the valley and low lying areas, as can be seen from the high activity detected by the control system SM6 in a valley on this phase. In the proposed layout turbines are even removed from the Moderate bat sensitivity buffer zones.		
	Without mitigation	**With mitigation**
Extent	Low-medium (2)	Low-medium (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: Adhere to the sensitivity map during turbine layout revisions.		
Cumulative impacts considering the other 2 phases: Because the three phases are located directly adjacent each other, if turbines are placed in areas of bat sensitivity the effect of the impact will be amplified across the entire Hidden Valley site. Since the species of concern are insectivorous and the only major predator of nocturnal flying insects, they contribute significantly to the local ecology. Therefore if significant numbers of bats are killed off insect numbers across the site will elevate as a zone favourable to insects are created across the larger area of the three phases.		

Nature: Bat mortalities due to direct blade impact or barotrauma during migration Migratory routes in the region are completely unknown, and there is no knowledge of whether any such migrations exist. But no known caves capable of providing roosting space

for migratory species are known to occur in the area. The migratory species *M. natalensis* have been detected in very low numbers on this phase. However, no bat migrations have been detected and the migratory species are present in very low numbers on the site.		
	Without mitigation	**With mitigation**
Extent	Medium-High (4)	Medium-High (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Improbable (2)	Very improbable (1)
Significance	**Medium (32)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: Continue bat monitoring to determine if migrations occur on site or not. If migrations occur affected turbines must be relocated on the layout before construction as to avoid impact to the migrating bats, or curtailed accordingly to avoid impact to migrating bats.		
Cumulative impacts considering the other 2 phases: If a migratory route are present through all three phases the probability of migrating bats being impacted by turbines are higher than with a single phase. But no migrations have been detected and the migratory species are present in very low numbers on all three phases.		

Nature: Destruction of bat roosts during construction Possible roosting spaces on site are mostly in the form of rock crevices where water erosion has exposed rock on hill slopes. Water drainage areas are demarcated in the sensitivity map and turbines are proposed in areas where multiple crevice roosts are unlikely.		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (8)**	**Low (8)**
Status (positive or negative)	Negative	Negative
Reversibility	Very low	Very low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » Adhere to the sensitivity map.		

***Cumulative impacts considering the other 2 phases**:* If bat roosts on one phase are destroyed there is a higher probability of artificial or alternative roosts to be repopulated quickly than if bat roosts are destroyed over the larger area of all three phases. This is due to the fact that bats resident in the neighbouring areas will move back faster and repopulate a smaller area faster. However the likelihood of impacting on bat roosts is low.

11.3.3 Comparative Assessment of Substation Alternatives

There will be no differences in the significance of impacts on bats for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable.

11.3.4. Cumulative impacts

Based on the information available at the time of undertaking this EIA, four wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site and there are other wind projects proposed in the area. Note that currently none of these projects are preferred bidders yet. Mortalities of bats due to multiple wind turbines in an region during foraging and migration can have significant ecological consequences as the bat species at risk are insectivorous and thereby contribute significantly to the control of flying insect at night. On a project specific level insect numbers in a certain habitat can increase if significant numbers of bats are killed off. But if such an impact is present on multiple projects in close vicinity of each other, insect numbers can increase regionally and possibly cause outbreaks of colonies of certain insect species. It is therefore essential that project specific mitigations be applied and adhered to for individual wind energy facilities, as there is it not possible to implement or advocate overarching mitigation on a regional level. Additionally if migrating bats are killed, it can have detrimental effects on the cave ecology of both caves that a specific colony utilises. This is due to the fact that bat guano are the primary form of energy input into a cave ecology system as no sunshine that allows photosynthesis exists in cave ecosystems. Cumulative impacts on bats due to multiple wind energy facilities in the region will be of a medium significance if project specific mitigations being implemented for each project.

11.3.5. Conclusions and Recommendations

Overall the proposed turbine positions for the Great Karoo wind farm had relatively low bat activity. The impact on bats is expected to be low. This statement carries the proviso that if subsequent layout revisions are required these adhere to the sensitivity map. No discoveries on site or in the data have been found that dictates the need to withhold environmental authorisation of the wind energy facility due to potential impacts on bats. It is recommended bat monitoring during the operational phase be carried out for the wind farm and that this is a condition of environmental authorisation.

11.4 Assessment of Potential Impacts on Soil, Land Use, Land Capability and Agricultural Potential

The soil excavations, construction of turbines, buildings, roads and power lines could lead to physical degradation of soil. During the operation of the wind energy facility soil impacts could include soil contamination / soil erosion by vehicles doing maintenance on site.

11.4.1 Impact on the project on Agricultural Potential

The site is located in an arid region of the Northern Cape. The agricultural potential of the Great Karoo Wind Farm site is very low due to soil and climatic constraints. The low agricultural potential of the site is the result of the dominance of shallow and rocky soils. There are no areas of irrigated agriculture on the site, only grazing of livestock (cattle and sheep). The only soils that are suited to agricultural production are found in the valley bottoms. These will not be impacted by the construction of wind turbines. The areas covered in shallow soils are considered to be suitable only to extensive grazing. This grazing potential is low due to vegetative cover and low biological (biomass) productivity. In addition, the rest of the site which is not occupied by wind turbines and other infrastructure will be able to continue the current land-use i.e. livestock grazing. Therefore the impact of the wind energy facility on agricultural potential of a low significance.

11.4.1.1 Impact Table - Agricultural Potential

Nature of Impact: Loss of land with high agricultural potential and land capability due to the development of the wind energy facility		
	Without mitigation	***With mitigation***
Extent	Low (1) – Site	Low (1) – Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance*	**16 (Low)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of	No	No

resources?		
Can impacts be mitigated?	Direct impacts cannot be mitigated but indirect impacts can be minimised and avoided through adequate planning of layout	
Mitigation: The loss of agricultural land is a long term loss and there are no mitigation measures that can be put in place to combat this loss. Mitigation is restricted to the limitation of the extent of the impact to the immediate area of impact and minimisation of off-site impacts.		
Cumulative impacts: Soil erosion may arise due to altered surface water runoff. Adequate management and erosion control measures should be implemented.		
Residual Impacts: The loss of agricultural land is a long term loss, however limited an arid are of low agricultural potential and to the footprint of the wind turbine and infrastructure will occupy a minimal percentage of the land, and that agriculture can still continue on the rest of the farm (not occupied by infrastructure for the facility). This loss extends to the post-construction phase albeit of a low to negligible significance.		

11.4.2Soil Erosion / Degradation during Construction

Soil erodability – the susceptibility of soil to erosion – is a complex variable, not only because it depends on soil chemistry, texture, and characteristics, but because it varies with time and other variables, such as mode of transport (i.e. wind or water). The erodibility of the soils on the site is associated with the sparse vegetation cover, thin soil profiles and steep slopes that characterise it. Soil degradation is the negative alteration of the natural soil profile, usually directly or indirectly related to human activity. Soil degradation due to construction activity will negatively affect soil formation, natural weathering processes, moisture levels and soil stability. This will, in turn, affect biological processes operating in the soil. Soil degradation includes erosion (i.e. due to water and wind), soil removal, mixing, wetting, compaction, pollution, salinisation, crusting, and acidification.

Soil erosion is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of *inter alia* chemical processes and/or physical transport on the land surface. Soil erosion can be accelerated by human activity is termed “accelerated erosion”.

Erosion of soil due to water run-off is generally considered as more important due to the magnitude of the potential impact over a relatively short period of time which can be very difficult to control. Erosion by water occurs when the force exerted on the soil by flowing water exceeds the internal shear strength of the soil and the soil fails and becomes mobilised into suspension. Erosion potential is typically increased in areas where soil is loosened and vegetation cover is stripped (e.g.

construction sites). Erosion sensitivity can be broadly mapped according to the severity of the potential erosion if land disturbing activities occur and this is generally related to the geology, soil types and the topography. Generally speaking, thick accumulations of unconsolidated or partly consolidated fine-grained soils of low plasticity along drainage lines and on moderate to steep slopes or at the base of steep slopes are most vulnerable to severe levels of erosion due to water run-off. These areas are typically called “highly sensitive” areas. Loose soil may also cause dust, relating to access roads and the use of vehicles on the site.

Specifically relating to the site in question, there are steep slopes within the site development footprint (refer to **Figure 11.7),** and the location of turbines on these steep slopes may cause accelerated erosion, in the absence of mitigation measures to prevent soil poison, particularly during construction. If soils are well managed during the construction and operational life of the facility, soil erosion / degradation or loss will not be a significant negative impact.

Figure 11.7: Slope map for the Great Karoo Wind Farm site

11.4.1.1 Impact Table – Soil erosion / degradation during construction

Nature: Soil degradation – Increased erosion due to construction activity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Very short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)

Significance	**Medium (40)**	**Low (18)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, moderate	Yes, minor
Can impacts be mitigated?	Yes	
Mitigation: • Restrict size of authorised disturbance areas. • Minimise activity on steep slopes / the side of slopes. • Implement effective erosion control measures. • Stage construction in phases to minimise exposed ground. • Keep to existing roads, where practical, to minimise impact on undisturbed ground. • Ensure stable slopes of stockpiles/excavations to minimise slumping. • Stockpiles should not exceed 2m in height unless otherwise permitted by the Engineer. • Stockpiles not used in three (3) months after stripping must be seeded to prevent dust and erosion, only if natural seeding does not occur.		
Cumulative impacts: The cumulative impact of soil erosion from all development in the area is considered low if mitigating measures are adhered to.		
Residual impacts: Minor – Localised movement of sediment. Slow regeneration of soil processes		

11.4.3 Soil Contamination / Soil Erosion during the Operation of the facility

During the maintenance activities (operations) of the site, the possibility for soil contamination exists in the event of spillage of oils, fuels or hydrocarbons used for maintenance of the wind turbines, substation or power line. In addition, spillage of fuels from vehicles may occur. These impacts on soil can be mitigated to a low significance.

11.4.3.1 Impact Table – Soil Contamination / Soil Erosion during the Operation of the facility

Nature: Increased pollution of soil by contaminants (e.g. fuel, oil, chemicals, cement).		
	Without mitigation	***With mitigation***
Extent	Local (1)	Local (1)
Duration	Medium term (2)	Very short term (1)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Low (12)**
Status	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Minor
Can impacts be mitigated?	Yes, to a certain extent	
Mitigation:	» Control use and disposal of potential contaminants or hazardous materials. » Remove contaminants and contaminated topsoil and replace topsoil in affected areas.	
Cumulative impacts:	» The cumulative impact of soil pollution is considered low due to the undeveloped nature of the study area.	
Residual impacts:	» Minor negative – slow regeneration of soil processes in and under topsoil	

11.4.4Comparative Assessment of Grid Connection Options

The soil types and the steep erosion sensitive slopes are similar for both substation or power line routing options. There are no major differences in the significance of impacts for either of the proposed substation alternatives in terms of impacts of soils or geology.

11.4.5. Cumulative impacts

The development of three projects in a clustered are have to potential to have negative impacts on soil, Soil erosion may arise due to altered surface water runoff. Adequate management and erosion control measures must be implemented. With good soil management, cumulative impacts can be prevented, provided that it is applied to all three development phases and other approved wind projects in the area.

11.4.7Conclusions and Recommendations

- The proposed development of the Great Karoo Wind Farm could have negative impacts on soils on the site. The wind energy facility on the site will not have a low impact on the impacts on land use, land capability and agricultural potential of the site (due to the low agricultural potential of the site).
- It is imperative though that adequate stormwater management measures be put in place as the soils on the site are highly prone to erosion due to shallow profiles and steep slopes. The main aspects that have to be managed on the site are:
  - Construction activities, particularly excisions, and access roads. Erosion must be controlled through adequate mitigation and control structures on turbine sites as well as along access routes.
  - Operational activities. Impacts from vehicles, such as spillages of oil and hydrocarbons, should be prevented and mitigated. Implement measures to avoid /reduce chemical spillages during the operation of the facility (such as spill kits).
  - Dust generation on site should be mitigated and minimised as the dust is a social nuisance.
- The following mitigation measures are recommended:
  - Minimise activity in erosion-sensitive areas
  - Implement effective erosion control measures.
  - Use existing roads, where practical, to minimise impact on undisturbed ground.
  - Use slope stabilisation techniques to ensure stable slopes of stockpiles/excavations to minimise slumping.
  - Site management has to be implemented with the appointment of a suitable environmental control officer (ECO) to oversee the process, address problems and recommend and implement corrective measures.
  - Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads).
  - Plan the road and site layout in such a way as to make maximal use of existing roads and fence/border areas to minimise impacts and to keep grazing and natural units as intact as possible.

11.5 Assessment of Potential Social Impacts

11.5.1 Construction - Creation of Employment and Business Opportunities and Opportunity for Skills Development

Construction can lead to direct and indirect social and economic positive impacts on a local and regional scale. The construction of one development phase (such as the Great Karoo wind farm) is expected to extend over a period of 16-18 months and create approximately 300 construction-related jobs, which have been broken down as follows:

» ~25 % (55) will be available to skilled personnel (engineers, technicians, management and supervisory)
» ~ 15 % (45) to semi-skilled personnel (drivers, equipment operators), and
» ~ 60% (180) to low skilled personnel (construction labourers, security staff).

However, it should be noted that the majority of construction workers, specifically the members from the local community, who are employed during the construction of Phase 3 (Great Karoo wind farm) are likely to be employed for Phase 1 and 2.

The total wage bill with the construction of the Great Karoo wind farm (300 employees X 18 months) is estimated to be in the region of R 66 million. This is based on the assumption that the average monthly salary for low, semi and skilled workers is R 5 000, R 12 000 and R 30 000 respectively.

The work associated with the construction phase will be undertaken by contractors and will include the establishment of the access roads and services and the erection of the wind turbines, substations and power line. Members from the local community are likely to be in a position to qualify for the majority of the low skilled and some of the semi-skilled employment opportunities. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local community. Given the high unemployment levels and limited job opportunities in the area this will represent a positive social benefit. The remainder of the semi-skilled and majority of the skilled employment opportunities are likely to be associated with the skilled contactors.

11.5.1.1 Impact Table - Creation of Employment and Business Opportunities during the Construction Phase

Nature: Creation of local employment and business opportunities during the construction phase associated with the wind energy facility.		
	Without Mitigation	**With Enhancement**
Extent	Local – Regional (2) (Rated as 2 due to potential opportunities for local communities and businesses)	Local – Regional (3) (Rated as 3 due to potential opportunities for local communities and businesses)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	***Medium (32)***	***Medium (36)***
Status	Positive	Positive
Reversibility	N/A	N/A
Irreplaceable loss of resources?	N/A	N/A
Can impact be enhanced?	Yes	
Mitigation: » Where feasible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi- and low-skilled job categories. » Before the construction phase commences the proponent should meet with representatives from the Local Municipality to establish what skills exist in the area and develop a database. » Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase. » The recruitment selection process should seek to promote gender equality and the employment of women wherever possible. » The proponent, in consultation with the Local Municipality, should develop a database of local companies, specifically companies that qualify as Black Economic Empowerment (BEE) companies that qualify as potential service providers prior to the commencement of the tender process for construction contractors.		
Cumulative impacts: Opportunity to up-grade and improve skills levels in the area. However, due to relatively small number of local employment opportunities and limited skills range, this benefit is likely to be limited.		
Residual impacts: Improved pool of skills and experience in the local area. However, due to relatively small number of local employment and skills-transfer opportunities this benefit is likely to be limited.		

11.5.2 Presence of construction workers in the area

The area can be described as a rural area that is sparely populated. In terms of affected farmsteads, there are a relatively small number of farmsteads where people reside that will be directly affected by the proposed project. The findings of the SIA indicate that the farmers in the area are opposed to construction workers being accommodated on the site. The risk posed to farm workers is an issue of concern. There are approximately 19 labourer's that live on the farms affected by the proposed wind energy facility and ~ 15 more on the adjacent farms. These workers are rural, farming folk, Afrikaans speaking people with limited few urban/ life skills and would be vulnerable to impacts associated with the presence of construction workers. In this regard there was an increase in teenage pregnancies and incidence of STDs in Sutherland and the local rural area road when the road between Sutherland and the SALT facility was surfaced. Due to Laingsburg location on the N1, prostitution, STDs, alcohol and drug abuse are existing issues of concern. These issues could be exacerbated by the presence of construction workers.

The potential risk to local residents in the area could potentially be mitigated by implementing a local employment policy, specifically for the low and semi-skilled employment opportunities associated with the construction phase. To perhaps prevent these negative impacts, the towns of Sutherland, Laingsburg and Matjiesfontein are all located within an hour's drive of the site and can be used to accommodate workers. Employing members from the local community to fill the low-skilled job categories would reduce the risk and mitigate the potential impacts on the local communities. These workers will be from the local community and form part of the local family and social network and, as such, the potential impact will be low. However, due to the potential mismatch of skills and low education levels, the potential employment opportunities for the members from these local communities may be low.

ACED has indicated that construction workers will not be accommodated on site and will be transported to and from the site on a daily basis, from Sutherland; Laingsburg or Matjiesfontein. Exposure to farm workers and their families is therefore expected to be minimal. While the risks associated with construction workers at a community level will be low, at an individual and family level they may be significant, especially in the case of contracting a sexually transmitted disease or an unplanned pregnancy. However, given the nature of construction projects it is not possible to totally avoid these potential impacts at an individual or family level.

11.5.2.1 Impact Table – impact of the presence of construction workers in the area on local communities

Nature: Potential impacts on family structures and social networks associated with the presence of construction workers		
	Without Mitigation	***With Mitigation***
Extent	Local (2)	Local (1)
Duration	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc. (5)	Short term for community as a whole (1) Long term-permanent for individuals who may be affected by STDs etc. (5)
Magnitude	Low for the community as a whole (4)	Low for community as a whole (4)
Probability	Probable (3)	Probable (3)
Significance	***Low for the community as a whole (21)***	***Low for the community as a whole (18)***
Status	Negative	Negative
Reversibility	No in case of HIV and AIDS	No in case of HIV and AIDS
Irreplaceable loss of resources?	Yes, if people contract HIV/AIDS. Human capital plays a critical role in communities that rely on farming for their livelihoods	
Can impact be mitigated?	Yes, to some degree. However, the risk cannot be eliminated	

Mitigation:

» Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically semi and low-skilled job categories. This will reduce the potential impact that this category of worker could have on local family and social networks;

» The proponent and the contractor should develop a Code of Conduct for the construction phase. The code should identify what types of behaviour and activities by construction workers are not permitted. Construction workers that breach the code of good conduct should be dismissed. All dismissals must comply with the South African labour legislation

» The proponent and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase;

» The movement of construction workers on and off the site, specifically construction workers from outside the area, should be closely managed and monitored by the contractors. In this regard the contractors should be responsible for making the necessary arrangements for transporting non-local workers to and from site on a daily basis;

» The contractor should make the necessary arrangements for allowing workers from outside the area to return home over weekends and or on a regular basis during the construction phase. This would reduce the risk posed by construction workers from outside the area on local family structures and social networks;

» It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.
***Cumulative impacts*:** Impacts on family and community relations that may, in some cases, persist for a long period of time. Also in cases where unplanned / unwanted pregnancies occur or members of the community are infected by an STD, specifically HIV and or AIDS, the impacts may be permanent and have long term to permanent cumulative impacts on the affected individuals and/or their families and the community.
Residual impacts: See cumulative impacts.

11.5.3 Construction - Risk of stock theft, poaching and damage to farm infrastructure

The presence of construction workers on the site increases the potential risk of stock theft and poaching, especially in an area that is sparsely populated and due to the fact that many landowners do not reside on the farms. The movement of construction workers on and off the site also poses a potential threat to farm infrastructure, such as fences and gates, which may also be damaged. Stock and game losses may also result from gates being left open and/or fences being damaged. In this regard, one of the landowners indicated that stock theft, specifically sheep, was a major concern. The landowner indicated that construction workers should not be housed on the site. The potential impacts associated with stock theft can, however, be effectively managed and mitigated, after which the impact significance is rated as low.

11.5.3.1 Impact Table – Stock theft and damage to farm infrastructure

Nature: Potential loss of livestock, poaching and damage to farm infrastructure associated with the presence of construction workers on site		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium **(33)**	Low **(24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock losses etc.	Yes, compensation paid for stock losses etc.
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	Yes
Mitigation: • The proponent should enter into an agreement with the local farmers in the area		

whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences; • The proponent should consider developing a Code of Conduct for construction workers. The Code of Conduct should be signed by the proponent and the contractors before the contractors move onto site; • The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below); • The EMP will outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested; • Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms. • Contractors appointed by the proponent must ensure that construction workers who are found guilty of stealing livestock, poaching and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation; • The housing of construction workers on the site should be limited to security personnel.
***Cumulative impacts*:** None**,** provided losses are compensated for.
Residual impacts: See cumulative impacts.

11.5.4 Increased risk of fires during construction

The presence of construction workers and construction-related activities on the site poses an increased risk of veld fires that in turn pose a threat to the natural fynbos vegetation, farmsteads, livestock and wildlife in the area. In the process, farm and tourism infrastructure may also be damaged or destroyed and human lives threatened. The issue of fire has been raised as a key concern by most farmers in the area, especially runaway fires in the summer months. The use of fire prevention and fire management strategies for the wind energy facility will reduce the risk of fires to a reasonable level.

11.5.4.1 Impact Table – Increased risk of fires

Nature: Potential loss of livestock, crops and houses, damage to farm infrastructure and threat to human life associated with increased incidence of grass fires		
	Without Mitigation	***With Mitigation***
Extent	Local (4)	Local (2)

Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium **(36)**	Low **(24)**
Status	Negative	Negative
Reversibility	Yes, compensation paid for stock and crop losses etc.	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	

Mitigation:

- » The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences.
- » Contractor to ensure that open fires on the site for cooking or heating are not allowed except in designated areas.
- » Contractor to ensure that construction related activities that pose a potential fire risk, such as welding, are properly managed and are confined to areas where the risk of fires has been reduced. Measures to reduce the risk of fires include avoiding working in high wind conditions when the risk of fires is greater. In this regard special care should be taken during the high risk dry, windy summer months.
- » Contractor to provide adequate fire fighting equipment on-site.
- » Contractor to provide fire-fighting training to selected construction staff.
- » As per the conditions of the Code of Conduct, in the advent of a fire being caused by construction workers and or construction activities, the appointed contractors must compensate farmers for any damage caused to their farms. The contractor should also compensate the fire fighting costs borne by farmers and local authorities.
- » Use of fire prevention and fire management strategies for the wind energy facility.

Cumulative impacts:

None, provided losses are compensated for.

Residual impacts:

See cumulative impacts.

11.5.5 Impact due to increase in traffic during construction

Road access to the proposed wind energy facility site is likely to be from the N2 and the R345 to Sutherland. Thereafter, access to the site is likely to be via the Komsberg gravel road (P2243), off the tarred R354. Potential social impacts are linked to damage to road surfaces, specifically of the P2443 gravel road, and delays during the actual movement of construction traffic. The movement of heavy construction vehicles during the construction phase has the potential to damage roads and create noise, dust and safety impacts for other road users. The movement of large, heavy vehicles also has the potential to create delays for other road users, specifically local famers and community members.

Several abnormal loads using large trucks will be associated with the construction phase. In addition, crawler cranes (~ 550 t) and assembly cranes may also need to be transported onto and off the site. Other heavy equipment will include normal civil engineering construction equipment such as graders, excavators, cement trucks, etc. If required, ACED will consider the upgrade of the farm gravel roads to the site for the transportation of the wind turbine components during construction. ACED will have to apply for a permit to transport abnormal loads on public roads. In order to avoid traffic congestion and road safety during construction, various mitigation measures and road safety measures can be used.

11.5.5.1 Impact Table – Increase in traffic during construction

Nature: Traffic congestion and associated noise, dust and safety impacts associated with movement of construction related traffic to and from the site on road / private roads.		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	Low **(27)**	Low **(18)**
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	No
Can impact be mitigated?	Yes	
Mitigation: » The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. This should include includes damage to local roads and internal farm roads. The agreement should be signed before the construction phase		

commences; » The proponent and contactor should meet with the local farmers to identify the best time of the day to transport heavy machinery on to the site so as to minimise potential disturbances to other road users; » The contractor must ensure that damage caused to roads by the construction related activities, including heavy vehicles, is repaired before the completion of the construction phase. The costs associated with the repair should be borne by the proponent; » Dust suppression measures must be implemented for heavy vehicles such as wetting of gravel roads on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers; » All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits.
Cumulative impacts: If damage to roads is not repaired then this will impact on the farming activities in the area and also result in higher maintenance costs for vehicles of local farmers and other road users. The costs will be borne by road users who were not responsible for the damage.
Residual impacts: See cumulative impacts

11.5.6 Damage to and loss of farmland during construction

The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the wind turbines, substations and power lines may damage active farmland. During construction some areas may not be able to be accessed / grazed by the landowner due to construction activities. Furthermore, construction vehicles or personnel could damage farming areas outside of the construction footprint.

The landowner is compensated for leasing of the land by ACED. Where properly planned, the final footprint of disturbance associated with a wind energy facility is small and is linked to the foundation of the individual wind turbines, services roads, substations and power line. The impact on farmland associated with the construction phase can therefore be mitigated by minimising the footprint of the construction related activities and ensuring that disturbed areas are fully rehabilitated on completion of the construction phase and that construction is limited to the area for the facility, so that farming activities may continue on areas that are not utilised by the wind energy facility. The impact can be reversed, as once construction is complete farming activities may resume on the site.

11.5.6.1 Impact Table – Damage to and loss of farmland during construction

Nature: The activities associated with the construction phase, such as establishment of access roads and the construction camp, movement of heavy vehicles and preparation of foundations for the wind turbines, sub stations and power lines will damage farmlands and result in a loss of farmlands for future farming activities.

	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (1)
Duration	Long term-permanent if disturbed areas are not rehabilitated (5)	Short term if damaged areas are rehabilitated (1)
Magnitude	Moderate (4)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	High **(60)**	Low **(16)**
Status	Negative	Negative
Reversibility	Yes, disturbed areas can be rehabilitated	Yes, disturbed areas can be rehabilitated
Irreplaceable loss of resources?	No, disturbed areas can be rehabilitated and farming can resume on the properties once the wind energy facility construction is complete	No
Can impact be mitigated?	Yes, by compensation	Yes

Mitigation:

- The proponent should enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. This should include damage to and loss of farm land. The agreement should be signed before the construction phase commences;
- The footprint associated with the construction related activities (access roads, turning circles, construction platforms, workshop etc.) should be minimised;
- All areas disturbed by construction related activities, such as access roads, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase;
- The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed to establish the project. The specifications for the rehabilitation programme should be drawn up the botanical specialist appointed as part of the EIA process;
- The implementation of the Rehabilitation Programme should be monitored by the ECO;
- ACED compensates farmers for leasing of the land for the wind energy facility, which is included in the rental agreement with the local landowners.

Cumulative impacts:

Overall loss of farmland could impact on the livelihoods of the affected farmers, their families and the workers on the farms and their families. However, disturbed areas can be rehabilitated.

***Residual impacts*:** See cumulative impacts.

11.5.7 Operational Phase -Creation of Long- Term employment and business opportunities

Based on information from other wind project, the establishment of a 150MW will create approximately 50 permanent employment opportunities, broken down as follows:

» ~20% (10) will be available to skilled personnel
» ~80% (40) to semi and low skilled personnel.

The operational phase is expected to last 20 years. Members from the local community are likely to be in a position to qualify for the majority of the low skilled and some of the semi-skilled employment opportunities. The majority of these employment opportunities are also likely to accrue to Historically Disadvantaged (HD) members from the local community. Given the high unemployment levels and limited job opportunities in the area this will represent a significant social benefit. The remainder of the semi-skilled and majority of the skilled employment opportunities are likely to be associated with people from outside the area.

Given the location of the proposed wind energy facility, the majority of permanent staff is likely to reside the local towns in the area, such as Laingsburg, Sutherland and Matjiesfontein. In terms of accommodation options, a percentage of the new permanent employees may purchase houses in one of these towns, while others may decide to rent. Both options would represent a positive economic benefit for the region. In addition, a percentage of the annual wage bill earned by permanent staff would be spent in the regional and local economy. This will benefit local businesses in the local towns in the area. The benefits to the local economy will extend over the 20-year operational lifespan of the project. The local hospitality industry is also likely to benefit from the operational phase. These benefits are associated with site visits by company staff members and other professionals (engineers, technicians etc.) who are involved in the company and the project but who are not linked to the day-to-day operations. The establishment of a Community Trust, as required in terms of the Request for Proposal Document prepared by the Department of Energy, will also create potential benefits for the local community.

11.5.7.1 Impact Table – Creation of Long- Term employment and business opportunities

Nature: Creation of long-term employment and business opportunities associated with the operational phase		
	Without Mitigation	***With Enhancement***
Extent	Local (1)	Local and Regional (4) (Assumes establishment of a Community Trust as indicated below)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)
Significance	Low **(27)**	Moderate **(56)**
Status	Positive	Positive
Reversibility	N/A	
Irreplaceable loss of resources?	No	
Can impact be enhanced?	Yes	

Enhancement:

» ACED to investigate the opportunities for establishing a Community Trust. The revenue for the trust would be derived from the income generated from the sale of energy from the wind energy facility and used to support local IDP projects and initiatives.

» The establishment of a Community Trust should be discussed with the Local Municipality.

» The proponent should implement a training and skills development programme for locals during the first 5 years of the operational phase. The aim of the programme should be to maximise the number of South African's and locals employed during the operational phase of the project.

Cumulative impacts:

Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities in the area. Creation of revenue stream to fund local projects, thereby enhancing local economic and social development in the area.

Residual impacts:

See cumulative impacts

11.5.8 Development of Renewable Energy Infrastructure

South Africa currently relies on coal-powered energy to meet more than 90% of its energy needs. As a result South Africa is one of the highest per capita producers of carbon emissions in the world and Eskom, as an energy utility, has been identified as the world's second largest producer carbon emissions (Cape Times, 15 November 2007).

The establishment of a clean, renewable energy facility will therefore reduce, albeit minimally, South Africa's reliance on coal-generated energy and the generation of carbon emissions into the atmosphere. The overall contribution to South Africa's total energy requirements of the proposed wind energy facility is relatively small. However, the ~ 150 MW installed capacity will contribute towards offsetting the total carbon emissions associated with energy generation in South Africa. Given South Africa's reliance on Eskom as a power utility, the benefits associated with an IPP based on renewable energy are regarded as significant.

The promotion of renewable energy sources is supported at national and provincial levels. As indicated above the fit with national and provincial energy policies should be viewed within the context of the site's location the potential impact on the areas sense of place and surrounding tourist related land uses. In addition, the current application is not unique. In this regard, a significant number of wind developments are currently proposed in the Northern Cape and other parts of South Africa. The potential contribution of this project should therefore be regarded as valuable, but should not be overestimated / exaggerated.

11.5.8.1 Impact Table – Contribution of the project towards Development of Renewable Energy Infrastructure in South Africa

Nature: Development of infrastructure to generate clean, renewable energy		
	Without Mitigation	**With Mitigation**
Extent	Local, Regional and National (4)	Local, Regional and National (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (56)**	**Medium (56)**
Status	Positive	Positive
Reversibility	Yes	
Irreplaceable loss of	Yes, impact of climate change on ecosystems	

resources?		
Can impact be mitigated?	Yes	
Enhancement: • Use the project to promote and increase the contribution of renewable energy to the national energy supply; • Implement a skills development and training programme aimed at maximising the number of employment opportunities for local community members; • Investigate the opportunities for establishing a Community Trust that would benefit local, disadvantaged and vulnerable communities.		
Cumulative impacts: Reduce carbon emissions via the use of renewable energy and associated benefits in terms of global warming and climate change.		
Residual impacts: See cumulative impacts		

11.5.9 Potential Impact of the wind energy facility on tourism in the region

Tourism in the study area can be described as modest, and is largely associated with the town of Sutherland and the small Victorian rail siding of Matjiesfontein. With regards to Sutherland, the commissioning of the South African largest Telescope (SALT) resulted in a boom in the local tourism sector, specifically in the town of Sutherland. The town currently receives an estimated 15 000 visitors annually. The modest tourism boom has had direct positive knock-on effects on local employment creation and the growth of the local retail sector.

The proposed Great Karoo site is located ~ 60 km to the south of the SAAO/SALT site and night-time light emissions from warning lights on the turbines may compromise the areas integrity with regard to observations from SALT, depending on the CAA requirements in this regard. This may be exacerbated by other wind projects that may be developed in the area, including the approved Moyeng Suurplaat wind project (400 turbines located ~30km east-north east of site) and proposed G7 Roggeveld wind project (250 turbines located to west of site). Negative impacts on SALT may impact on the day-to-day operations of the observatory and also impact negatively on local tourism industry. However, approval of the Hidden Valley wind project will be contingent on ACED's ability to prove that the facility will not contravene the provisions of the Astronomy Geographic Advantage (AGA) Act (2007).

Other existing tourism initiatives around Sutherland are largely concentrated to the north (towards Calvinia) and west (Ceres) of the town. The area towards the south-east of Sutherland – i.e. the Hidden Valley area – is essentially undeveloped, and does not form part of any of the current tourism development initiatives.

However, the activities on the Komsberg Wilderness Nature Reserve (KWNR), located in the Komsberge ~ 5-7 km north of the wind energy facility site, may be negatively impacted. The KWNR is ~12 000 ha in extent, and consists mainly of rehabilitated veld. A number of large mammal species have been reintroduced, including mountain zebra, red hartebeest, gemsbok, and brindled and black wildebeest. A number of scenic lookout points along the Great Escarpment are located in the KWNR. The KWNR currently uses the property primarily for the sake of non-profit conservation (i.e. no public game viewing, hunting, tourism accommodation, etc.). The KWNR offers working holidays on the property, mainly to paying British volunteers who typically come out for periods of 10 days or so. Volunteers stay in the Komsberg farmstead, located on the property (~7 km from nearest proposed turbine location). The experience of the visitors to the KWNR may be negatively impacted by the presence of wind turbines.

In addition, given that there are a number of other wind project proposed in the area the potential benefits to tourism associated with the novelty and scale of the project should not be overstated, and need to be carefully balanced against potential losses of open spaces and scenic vistas. The potential impact on future wilderness-based tourism options also need to be taken into account by the authorities. As indicated above, the impact on the sense of place and the landscape character of the area may be a concern. Findings from studies undertaken in Scotland indicate that there appears to be no clear evidence that tourists would be put off by the presence of wind farms. In this regard far more visitors appeared to associate wind farms with clean energy than with landscape damage, suggesting that they could help to promote Scotland's reputation as an environmentally friendly country as long as they are sensitively sited. This argument could also apply to the South African context. However, the research does note that this could change as more wind projects are built. This applies to the study area and other parts of South Africa.

The impact on tourism is linked to the visual impact on the areas sense of place and landscape character. The findings of the VIA (MetroGIS, March 2012) indicate that the while the area surrounding the site is itself not a major tourist attraction, the R354 is a primary tourism route for visitors to the town of Sutherland and its attractions. The visual impact on the R354 is expected to be of low to moderate negative significance. No mitigation is possible. The findings for the VIA for the Great Karoo wind farm is that the visual impact will be of a medium significance.

The findings of the Visual Impact Assessment (VIA) (MetroGIS, March 2012) also indicate that the potential for mitigating the impact on the area's sense of place and the landscape is low. In this regard, the Australian National Wind Farm

Development Guidelines stress the importance of general location and site selection.

Research in Scotland undertaken by Warren and Birnie (2009) found that there appeared to be no clear evidence that tourists would be put off by the presence of wind farms in tourism areas. In this regard, the research found that far more visitors appeared to associate wind farms with clean energy than with landscape damage, suggesting that they could help to promote an area's reputation as an environmentally friendly area, provided they are sensitively sited. However, the paper notes that this could change as more are built. The key lesson for South Africa is this regard is that wind farms should be located in areas that minimise the potential impact on landscapes and as such also reduce the potential impact on tourism.

11.5.10.1 Impact on tourism industry

Nature: Potential negative impact of the wind energy facility on local tourism		
	Without Mitigation	***With Mitigation***
Extent	Local (3)	Local (3)
Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Medium **(33)**	Medium **(33)**
Status	Negative	Negative
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impact be mitigated?	No	
Mitigation: In terms of mitigating the visual impacts, it is virtually impossible to hide the facility. The impact on the sense of place of the area cannot therefore be effectively mitigated.		
Cumulative impacts: Potential for fewer tourists to visit the area, and impact on tourist sector (Negative) – however unproven in South Africa		
Residual impacts: See cumulative impacts		

11.5.10 Potential Health Impacts due to the Operation of the wind energy facility

The potential health impacts typically associated wind energy facilities include, noise (discussed as a separate impact in this report), shadow flicker and electromagnetic radiation. The findings of a literature review undertaken by the Australian Health and Medical Research Council published in July 2010 indicate that there is no evidence of wind farms posing a threat to human health. The research also found that wind energy is associated with fewer health effects than other forms of traditional energy generation (WHO, 2004).

Based on these findings it is assumed that the significance of the potential health risks posed by the proposed Great Karoo Wind Farm is of low significance. The potential noise impacts are covered in the specialist Noise Impact Assessment.

11.5.11 Comparative Assessment of Grid Connection Options

No specific preference for substation alternatives made, as the location of the substation does not directly have any social impacts on any people who reside in or around the site (which is a sparsely populated region).

11.5.12. Cumulative Social Impacts

Based on the information available at the time of undertaking this EIA, two wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site namely:

- The authorised The Mainstream Konstabel wind energy facility.
- The authorised Suurplaat Wind Energy Facility (Moyeng Energy) which is located ~15.6 km east of the Hidden Valley site); and
- The Roggeveld Wind Farm (a G7 project) which is located adjacent to the Hidden Valley site (on the western side only), where the EIA is underway.

Cumulative social impacts include the Great Karoo wind farm, and the other two development phases, as well as the three other wind projects that are approved in the area include:

- Positive impact from job creation and indirect socio-economic spin-offs.
- Potential cumulative negative visual impacts from several wind projects in the region.

e) Job Creation

Logically, having more than one wind project in this region will have cumulative positive social impact due to job creation during construction and operations. This impact is attempted to be quantified here. It should be noted that the majority of construction workers, specifically the members from the local community, who are employed during the construction of Phase 3 (Great Karoo Wind Farm) are likely to be employed for Phase 1 and 3. Phase 1 and 3 will therefore not employ an additional 600 workers. For the purposes of the SIA it is assumed that 80% of the workers employed in Phase 3 will be employed during Phase 1 and 2. The total number of construction related employment opportunities associated with all three Phases 1, 2 and 3 will therefore be ~ 420. The total additive wage bill for Phase 1, 2 and 3 will therefore be ~ R 198 million. For the purposes of the SIA it is assumed that the operation of a 450MW site can be undertaken by 100 permanent workers.

f) Visual Impacts

It is obvious, that the overall visual impacts associated with a 450MW wind energy facility will be greater than the visual impacts associated with a 150MW facility. Furthermore having several projects in a region will also have a greater visual impact. Refer to Section 11.5 for more information on visual impacts.

The Australian Wind Farm Development Guidelines (Draft, July 2010) indicate that the cumulative impact of multiple wind farm facilities is likely to become an increasingly important issue for wind farm developments in Australia. This could occur in South Africa. In terms of assessing cumulative impacts, the Scottish Natural Heritage (2005) describes a range of potential cumulative landscape impacts of wind farms on landscapes, including:

» Combined visibility (whether two or more wind farms will be visible from one location).
» Sequential visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail).
» The visual compatibility of different wind farms in the same vicinity.
» Perceived or actual change in land use across a character type or region.
» Loss of a characteristic element (e.g. viewing type or feature) across a character type caused by developments across that character type.

The guidelines also note that cumulative impacts need to be considered in relation to dynamic as well as static viewpoints. The experience of driving along a tourist road, for example, needs to be considered as a dynamic sequence of views and visual impacts, not just as the cumulative impact of several developments on one location. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (National Wind Farm Development Guidelines, DRAFT - July 2010).

The potential cumulative impacts are largely linked to the visual impact of the turbines and power lines on the areas sense of place and landscape character. It is obvious, that the overall visual impacts, and hence cumulative impacts, associated with all three development phases (i.e. 450MW project) will be greater than the cumulative impacts associated with a 150MW facility. The cumulative impacts associated with the proposed Hidden Valley project (regardless of size) are exacerbated by the sites location in relation to the approved Moyeng Suurplaat wind project (400 x turbines, 1200 MW), the G7 Roggeveld wind project (250 x turbines, 550 MW) and the approved Konstabel wind project. The potential for cumulative impacts is therefore potentially high. None of the projects in this area have, however, been awarded preferred bidder status at this time.

The issue of Sequential Visibility (e.g. the effect of seeing two or more wind farms along a single journey, e.g. road or walking trail) is therefore a concern. The potential cumulative impacts are also highlighted by the findings of the VIA (refer to Section 11.5).

In summary, the proposed establishment of three or possibly other wind energy facilities in the area will impact negatively on the landscape and the areas rural sense of place and character.

11.5.14 Conclusions and Recommendations

There will be net positive and negative social impacts from the development of the Great Karoo Wind Farm. The following is the pertinent recommendations of the SIA, to be included in the EMPr and to be considered by the decision-making authority:

» The establishment of a community trust funded by revenue generated from the sale of energy the project.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» Use of fire prevention and fire management strategies for the wind energy facility, to reduce risks to landowners.
» Negative cumulative social (visual) impacts are a concern due to the number of proposed wind projects in this region of the Northern Cape. The establishment

of a number of large wind projects in the area will have a significant impact on the landscape and the areas rural sense of place and character.

The proposed development represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society as a whole. The cumulative impacts associated with the establishment of a number of proposed wind energy facilities in the area on the local sense of place and landscape cannot be ignored. Likewise the potential employment and community trust related benefits will also increase with the increase in the size of the proposed project.

11.6 Assessment of Potential Visual Impacts

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General. The approach utilised to identify issues related to the visual impact included the following activities:

» The creation of a detailed digital terrain model (DTM) of the potentially affected environment;
» The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc.;
» The identification of sensitive environments upon which the proposed facility could have a potential impact;
» The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

The visual character of the sites consists of bands of mountainous terrain, below the escarpment. The site is remote, is an area with small numbers of permanent dwellers. Many of the adjacent landowners do not reside on their farms. This visual character has to a large extent determined the significance of the visual impact on the wind energy facility.

11.6.1 Visual Exposure of Phase 1 – Great Karoo wind farm

The result of the combined viewshed analyses for the proposed wind energy facility's layout is shown on **Figure 11.8.** The viewshed analysis not only indicates areas from where the wind turbines would be visible (any number of turbines with a minimum of one turbine), but also indicates the potential frequency of visibility (i.e. how many turbines are exposed).

The dark orange areas indicate a high frequency (i.e. 70-77 turbines or parts thereof may be visible) while the yellow areas represent a low frequency (i.e. 1-8 turbines or parts thereof may be visible).

Potential visual exposure as a result of the proposed Great Karoow wind farm is focussed primarily to the north and west of the study area. Visual exposure is moderate to high to the north and west, but is limited to a radius of about 8km by ridgelines and mountains.

Visual exposure to the west is limited to the farm portions (and turbine sites) reserved for Phase 1 and Phase 2 of the Hidden Valley wind energy facility. Only three settlement nodes are identified in this area, namely De Hoop, Oranjefontein and Bobbejaansfontein.

There is very limited potential visual exposure along the crests of south and east facing ridges beyond a 10 km radius. None of these areas are settled or traversed by roads.

There is a high frequency of potential visual exposure is on the site itself with up to 77 turbines may be visible from within this are, due to the elevated location of the proposed turbines. The settlement of De Plaat is located in the centre of this area.

The frequency of visual exposure is moderate to high to the immediate south and east of the site (5km radius), with visual exposure beyond this radius being limited to exposed south and west facing ridgelines. Potentially affected settlements with a high potential exposure are Damslaagte and Meintjiesplaas to the south and Kareedoornkraal to the east.

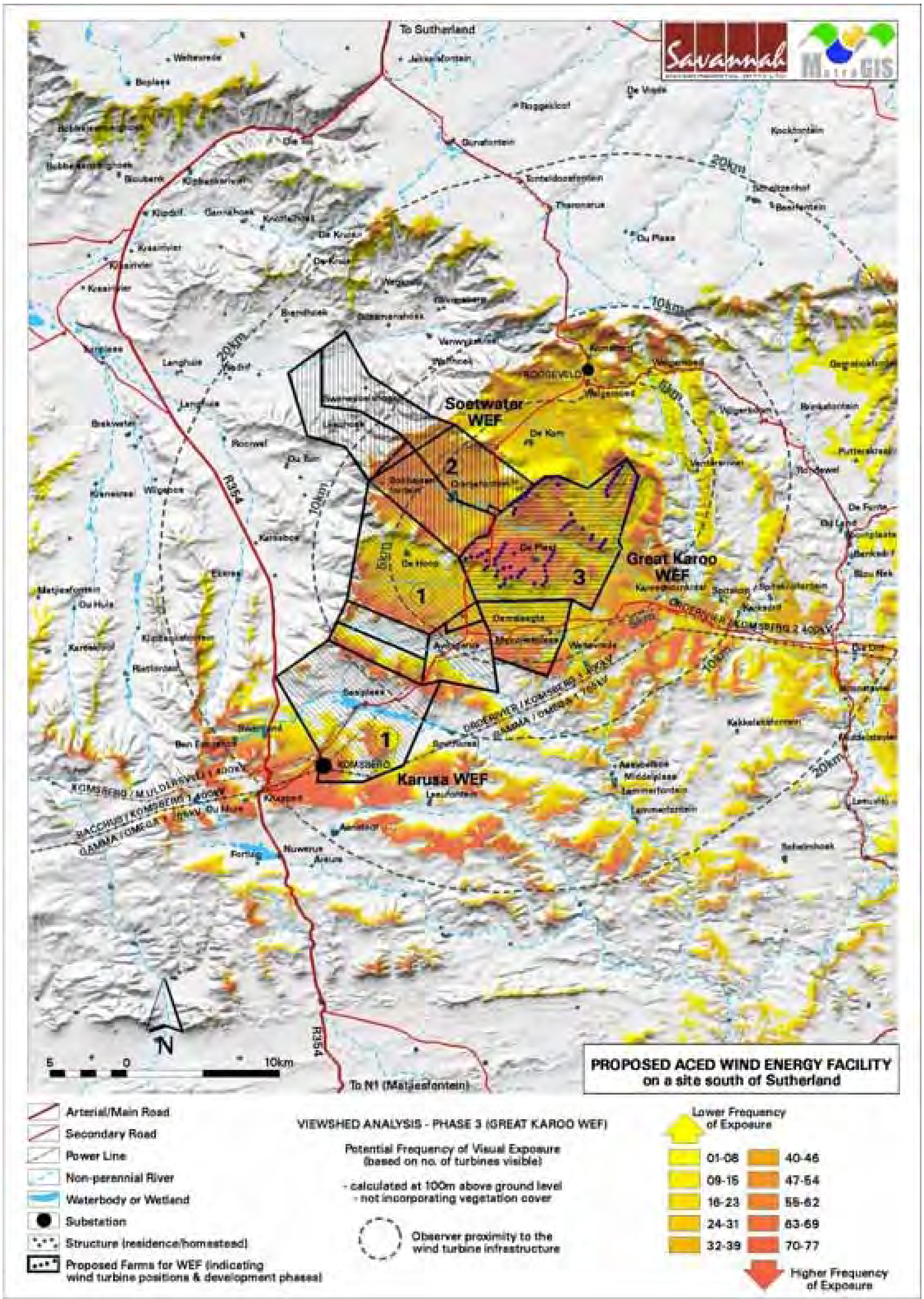

Figure 11.8: Viewshed Analysis of the proposed Great Karoo Wind Farm

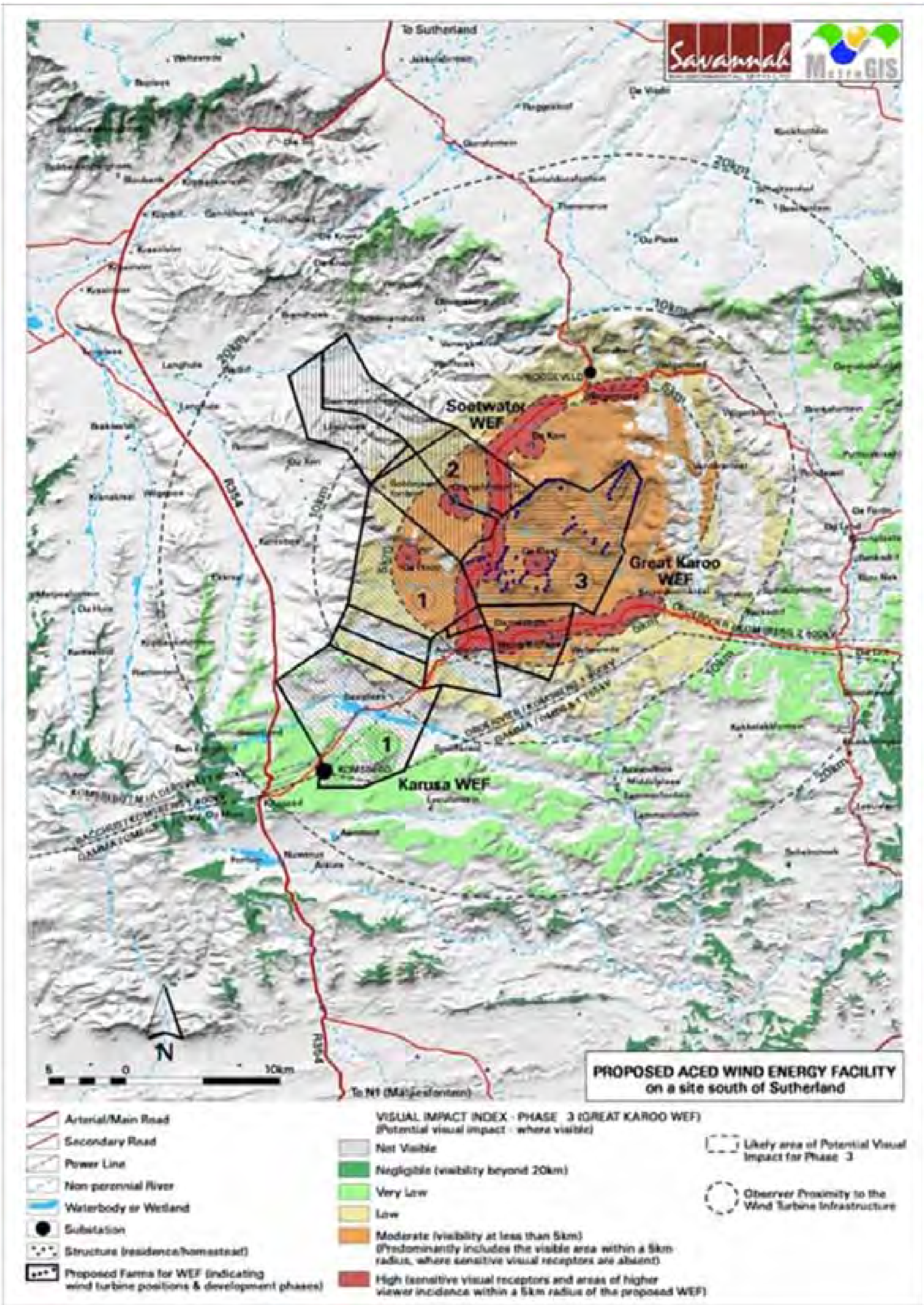

Figure 11.9: Visual impact index of Phase 3 (Great Karoo Wind Farm) of the proposed Hidden Valley wind energy facility.

The topography and the placement of the wind turbines on the high ground influence the frequency of exposure. The following is of relevance:

» There exists a core area of potentially moderate visual impact on the site itself and within a 5km radius of the proposed wind energy facility. There are several visually screened patches towards the eastern periphery of this zone.
» Potential areas of high visual impact within this 5km radius include a stretches of the secondary road between the Komsberg substation and the Roggeveld substation and the secondary road following the Droerivier/Komsberg Powerline. Several settlements and homesteads also fall within this 5km radius. These receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 76 turbines). Specific homesteads and settlements include the following:
  - De Kom;
  - De Plaat;
  - Oranjefontein;
  - De Hoop;
  - Damslaagte;
  - Meintjiesfontein;
» The extent of potential visual impact is Low between the 5km and 10km radius, while the hilly topography results in large visually screened patches. Areas of potentially moderate visual impact are restricted to roads and only a few settlements.
» Discontinuous stretches of secondary roads to the south-west, soth-east and north of the site, will be exposed to potentially moderate visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 76 turbines). Homesteads and settlements include the following:
  - Bobbejaanfontein
  - Komsberg;
  - Welgemoed;
  - Spitskop;
  - Kareedoornkraal;
  - Weltevrede.
» Beyond the 10km radius (but within the 20km radius), the extent of potential visual impact decreases quite markedly, with visually exposed areas located mainly in the south and east. The magnitude of visual impact in the visually exposed areas is reduced to very low.
» Large areas in the north and west of this zone are visually screened by the elevated plateau and undulating topography.

- Sensitive visual receptors likely to be exposed to high frequencies of visual exposure include a small section of the R354 and secondary road near kruispad, and limited discontinuous stretches of secondary roads to the east. These receptors are likely to experience low visual impact. A number of settlements and homesteads are likely to experience a similar impact. These are located primarily in the east of the zone.
- Affected homesteads and settlements include the following:
  - Gemsbokfontein;
  - Putterskraal;
- In the longer distance (i.e. beyond the 20km radius), visual exposure is further reduced in both extent and magnitude. Visual impacts are likely to be negligible.
- Visual receptors include the elevated ridges to the west, east and south.

11.6.1.1 Photo Simulations

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the wind energy within the receiving environment. Refer to Visual Assessment (Appendix I) for the remainder of the photo-simulations. Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the proposed wind energy facility within the receiving environment. The purpose of the photo simulation exercise is to support the findings of the VIA, and is not an exercise to illustrate what the facility will look like from all directions.

The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility. The simulations are based on the wind turbine dimensions and layout as indicated on **Figure 11.10 and Figure 11.11.**

Each photographic simulation is preceded by a panoramic overview of the landscape from the specified viewpoint being discussed. The panoramic overview allows for a more realistic viewer scale that would be representative of the distance over which the turbines are viewed. Where relevant, each panoramic overview indicates the section that was enlarged to show a more detailed view of the wind energy facility. The simulated wind turbines, as shown on the photographs, were adapted to the atmospheric conditions present when the original photographs were taken. This implies that factors such as haze and solar glare were also simulated in order to realistically represent the observer's potential view of the facility.

Figure 11.10-.: Photo simulation of the possible view of the wind turbines from the R354 road

Viewpoint 2 is located on the arterial R354 to the west of the proposed wind energy facility, a short distance north of viewpoint 2. The point is located approximately 10km away from the closest turbine of the Great Karoo wind farm. The viewing direction is south easterly and is representative of a medium distance view that residents of local homesteads and visitors to the area will experience while travelling this road between Sutherland and Matjiesfontein. Approximately ***71*** *turbines are fully or partially visible in the landscape.*

Figure 11.11.: Photo simulation of the possible view of the wind turbines from the secondary road that traverses the site

Viewpoint 3 is located on the secondary road which traverses the proposed Hidden Valley wind energy facility, running from the R354 in the south west to the Roggeveld Substation to the north east of the site. The point is located on the boundary of the proposed Great Karoo Wind Farm site approximately less than 1km away from the closest turbine. The viewing direction is south westerly and is representative of a short distance view that residents of local homesteads and visitors to the area will experience while travelling along this secondary road. Approximately ***95*** *turbines are fully or partially visible in the landscape***.**

11.6.1.2 Impact Table - visual impact on residents of settlements and homesteads within 5 km from the site

Nature: Potential visual impact on residents of settlements and homesteads in close within 5 km from the site		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/A
Duration	Long term **(4)**	N/A
Magnitude	Low (4)	N/A
Probability	Highly Probable (4)	N/A
Significance	**Medium (48)**	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Recoverable **(3)**	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	No	N/A
Mitigation: None.		
Cumulative impacts: The construction of up to 77 wind turbines will increase the cumulative visual impact within the region.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

11.6.2 Change of visual character and sense of place of the region

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc.) play a significant role. A visual impact on the "sense of place" is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

Specific aspects contributing to the sense of place of this region include the pastoral visual quality of the farmland and the scenic beauty of the coastline and of the mountains inland. The anticipated visual impact of the facility on the regional visual character, and by implication, on the sense of place, is expected to be moderate. There is no mitigation for this impact.

11.6.2.1 Impact Table - visual character and sense of place

Nature of Impact: Potential visual impact on the visual character and sense of place of the region.		
	No mitigation	***Mitigation Considered***
Extent	Regional **(3)**	N/A
Duration	Long term **(4)**	N/A
Magnitude	Moderate **(6)**	N/A
Probability	Probable **(3)**	N/A
Significance	Moderate **(39)**	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Recoverable **(3)**	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	No	N/A
Mitigation: Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: The construction of up to 77 wind turbines will increase the cumulative visual impact within the region.		
Residual impacts: None. The visual impact of the wind turbines will be removed after decommissioning.		

11.6.3. Lighting Impacts

The area immediately surrounding the proposed facility has a relatively low incidence of receptors and light sources, so light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The wind energy facility may contribute to the effect of sky glow in an otherwise dark environment. Lighting impacts will be moderate significance both before and after mitigation.

The SALT is situated at the South African Astronomical Observatory (SAAO) field station 14km east of the town of Sutherland. This site, in the arid Karoo region, was established in the early 1970's and was chosen for its dark and clear skies and good weather conditions. The site is 35km to the north east of the proposed wind energy facility and lies on an elevated plateau. The SALT lies on the plateau at an elevation of 1777m ASL. The highest turbine elevations are expected to be at approximately 1500m ASL (height of hub of most elevated turbines).

While light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity, it is not possible to see these lights from the SALT due to elevated topography which limits visibility to 10km to the north east.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low. The furthest extent of direct visibility of turbine hubs and lights in the direction (NE) of the SALT is 10km.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow. This impact is the only light impact with the potential to affect the SALT.

The intensity of light generated by the wind energy facility is expected to be of a lower order than that generated by the urban area of Sutherland due to the dispersed nature of the turbines. The distance of the SALT from the wind energy facility and the elevated position of the SALT reduce the significance of this impact to insignificant.

11.6.3.1 Impact Table - Significance of visual impact of lighting at night on visual receptors in close proximity to the proposed wind energy facility

Nature of Impact: Potential visual impact on of lighting at night on visual receptors in close proximity to the proposed wind energy facility.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Low **(4)**
Probability	Probable **(3)**	Probable **(3)**
Significance	Moderate **(42)**	Moderate **(36)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	N/a
Mitigation: Planning: mounting aircraft warning on the turbines representing the outer perimeter of the facility. Planning: pro-active lighting design and planning. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of 77 wind turbines with their aircraft warning lights will increase the cumulative visual impact of such warning lights within the region. This is specifically relevant in context of the two projects near the Great Karoo Wind Farm which have been authorised by DEA.		
Residual impacts: None. The visual impact of lighting will be removed after decommissioning and the removal of the wind turbines.		

11.6.4. Shadow flicker

Shadow flicker occurs when the sky is clear, and when the rotor blades are between the sun and the receptor (i.e. when the sun is low). De Gryse in Scenic Landscape Architecture (2006) found that "most shadow impact is associated with 3-4 times the height of the object". Based on this research, a 500m buffer along the edge of the facility is submitted as the zone within which there is a risk of shadow flicker occurring. In this respect, inhabited settlements and homesteads within the site, as well as those within 500m of the property boundary may experience a visual impact of low significance both before and after mitigation.

Shadow flicker only becomes an issue if a wind turbine is in close proximity to houses / dwelling. To avoid shadow flicker, ACED to put in a turbine separation distances to avoid shadow flicker. Taking into account site constraints ACED should use a minimum spacing of 5 rotor diameters (approximately 560m) based on our maximum turbine envelope in the prevailing (bi-directional east west) wind directions, 3 rotor diameters (approximately 336m) for non-predominant.

11.6.6.1 Impact Table - Significance of visual impact of shadow flicker

Nature of Impact: Potential visual impact of shadow flicker on visual receptors in close proximity to the proposed wind energy facility.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(1)**
Significance	Low **(24)**	Low **(12)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	N/a
Mitigation: Planning: ensure that all wind turbines are 500m or further from the nearest inhabited homestead of settlement. Decommissioning: removal of the wind turbines and ancillary infrastructure after 20 to 30 years		
Cumulative impacts: None.		
Residual impacts: None. The visual impact of shadow flicker will be removed after decommissioning and the removal of the wind turbines.		

11.6.6. The potential to mitigate visual impacts

It is not possible to mitigate the primary visual impact, namely the appearance of the wind energy facility (the wind turbines). The functional design of the turbines (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*". Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact. The overall potential for mitigation is generally low or non-existent.

Mitigation of visual impacts associated with the construction of roads includes the use of existing roads wherever possible.

Where new roads are required, these should be planned taking due cognisance of the topography. Construction of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems. Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning. It is recommended that the substation design makes use of low profile construction technology to mitigate visual impact on the surrounding area.

The Civil Aviation Authority (CAA) prescribes that aircraft warning lights be mounted on the turbines. However, it is possible to mount these lights on the turbines representing the outer perimeter of the facility. In this manner, fewer warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact. The regulations for the CAA's *Marking of Obstacles* should be strictly adhered to, as the failure of complying with these guidelines may result in the developer being required to fit additional light fixtures at closer intervals thereby aggravating the visual impact.

Mitigation of other lighting impacts includes the pro-active design, planning and specification lighting for the facility by a lighting engineer. The correct specification and placement of lighting and light fixtures for the turbines and the ancillary infrastructure will go far to contain rather than spread the light. Additional measures include the following:

» Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
» Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights;
» Making use of minimum lumen or wattage in fixtures;
» Making use of down-lighters, or shielded fixtures;
» Making use of Low Pressure Sodium lighting or other types of low impact lighting.
» Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

Mitigation of potential shadow flicker impacts includes ensuring that all wind turbines are located 500m or further from the nearest inhabited homestead of settlement. Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of the construction site. Construction should be managed according to the following principles:

» Reduce the construction period through careful planning and productive implementation of resources.
» Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing.
» Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
» Ensure that rubble, litter and disused construction materials are managed and removed regularly.
» Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way
» Reduce and control construction dust through the use of approved dust suppression techniques.
» Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
» Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.
» Secondary impacts anticipated as a result of the proposed wind energy facility (i.e. visual character and sense of place) are not possible to mitigate.
» There is no mitigation to ameliorate the negative visual impacts on tourist routes, destinations and potential of the region.
» Once the wind energy facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated.

The possible mitigation of both primary and secondary visual impacts as listed above should be implemented and maintained on an on-going basis.

11.6.7. Cumulative impacts

Figure 11.12 shows the potential cumulative visual exposure of the three development phases (Phase 1 Phase 3 (Great Karoo) and Phase 3). The cumulative visual impact is highest within a 5km radius of the turbine infrastructure. This impact moderates with distance. Slopes that have aspects that face the wind energy facility experience very high visual impact. There are several visually screened patches towards the eastern periphery of this zone. 15 settlements that will experience visual impact fall within this zone. 11 of these settlements potentially experience a very high visual impact. These are further categorised in terms of intensity of visual impacts.

Potential areas of high intensity visual impact (3 phases visible) within this 5km radius include a stretch the secondary road running north-south through the centre of the wind energy facility and two settlements located centrally within the wind energy facility, namely:

- De Hoop;
- Oranjefontein.

Areas of high intensity visual impact (3 phase visible) are restricted to within the footprint of the wind energy facility.

Potential areas of moderate intensity visual impact (2 phases visible) within this 5km radius include a stretch the secondary road running north from the northern periphery of the wind energy facility towards the Roggeveld substation and a short stretch of secondary road west of Meintjiesplaas. Five settlements are identified as having a moderate intensity visual impact within this zone, namely:

- Meintjiesplaas;
- De Plaat;
- Bobbejaanfontein;
- De Kom;
- Ou Tuin.

A stretch of the R354 in the west, as well as discontinuous stretches of secondary roads to the south and east of the site, will be exposed to potentially moderate visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to higher frequencies of visual exposure.

Based on the information available at the time of undertaking this EIA, two wind energy facilities that have an environmental authorisation occur in close proximity to the Hidden Valley site namely:

- The authorised The Mainstream Konstabel wind energy facility.
- The authorised Suurplaat Wind Energy Facility (Moyeng Energy) which is located ~15.6 km east of the Hidden Valley site); and
- The Roggeveld Wind Farm (a G7 project) which is located adjacent to the Hidden Valley site (on the western side only), where the EIA is underway.

Cumulative visual impacts include the Great Karoo Wind Farm, and the other two development phases, as well as the three other wind projects that are approved in the area include. This would imply an incremental increased in visual impact in this region of the Karoo. On the other hand, from a visual perspective, the overlapping viewshed may be favourable, as it represents the consolidation and concentration of potential visual impacts within a clustered zone of 15-20 km.

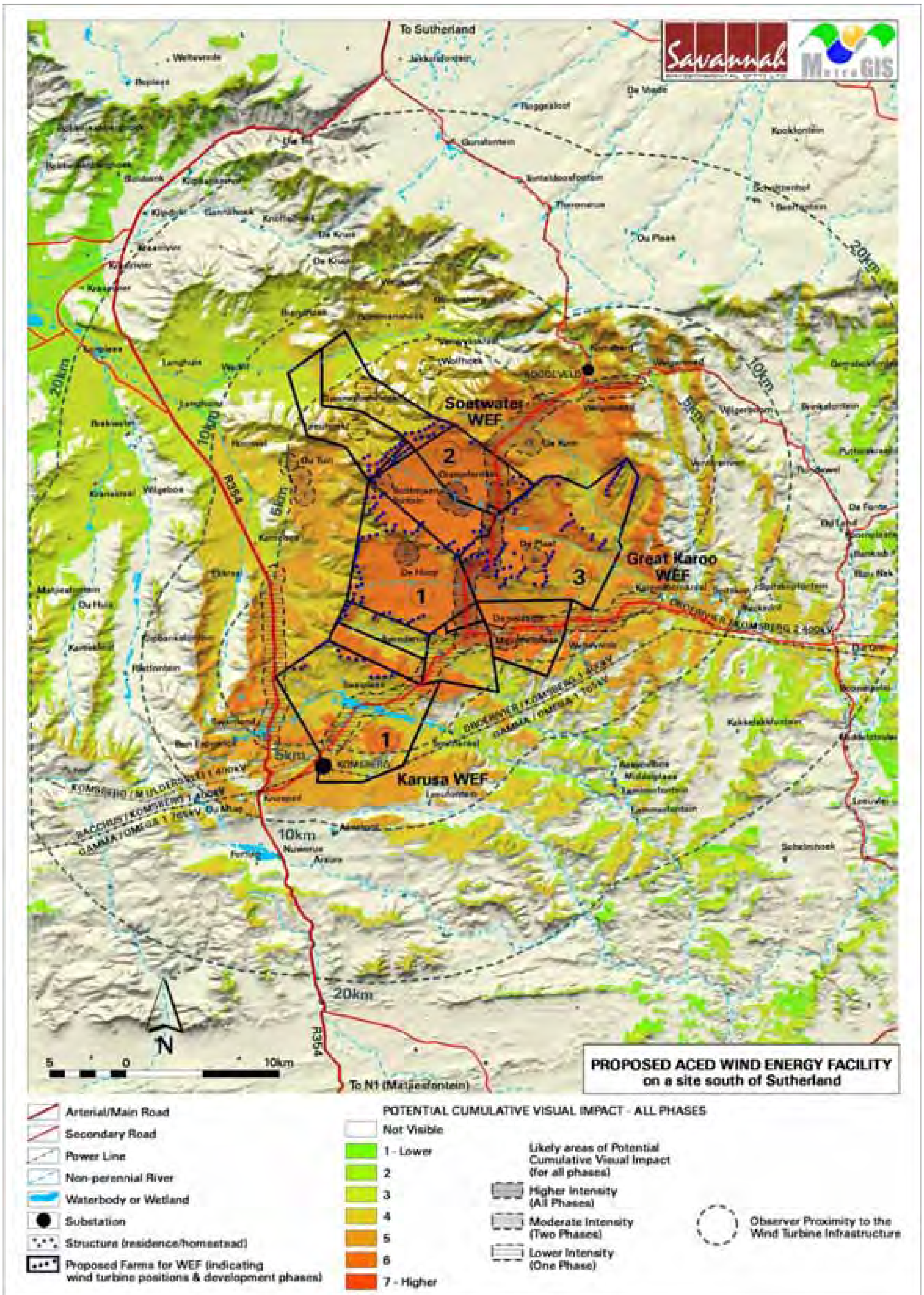

Figure 11.12: Cumulative Visibility analyses (for the three development Phases of the Hidden Valley project).

11.6.8. Comparative Assessment of Substation Options

There will be no differences in the significance of visual impacts for any of the alternative substation or power line routings. This is because the region in which the site is located is sparsely populated, with large distances between one homestead and the next. Furthermore, the visual landscape is already disturbed with the current 400 kV substation and power line that is located on the site as well as power lines, which the substation will be located next to. Therefore both proposed alternatives are considered acceptable from a visual impact perspective.

11.6.9. Conclusions and Recommendations

The construction and operation of the proposed Karusa Wind Energy Facility and its associated infrastructure will have a visual impact on the visual environment especially within, but not limited to the area within 8km of the proposed facility. Beyond this visual impact is reduced by the screening effects of the rugged topography and the contained nature of the site. The exception to this is a corridor of visual intrusion up the Tankwa River valley, however there are very few visual receptors in this area.

The low density of visual receptors in the study area results in a low intensity of visual impact, however the significance of the impacts is moderate to high as a result of undeveloped character of the landscape.

The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants.

However, these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements and tourists passing through or holidaying in the region.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development. The character of the site will be altered by the presence of the wind energy facility.

A number of mitigation measures have been proposed (section 5.9), which, if implemented and maintained, will reduce the significance of the certain visual impacts associated with the proposed Wind Energy Facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. The anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent.

As such, the facility would be considered to be acceptable from a visual perspective.

11.7 Assessment of Potential Noise Impacts

11.7.1Relevant Noise Receptors

There are no residential communities close to the proposed development. The study area has a rural character in terms of the background sound levels. Potentially Sensitive Receptors (PSRs), also known as Noise-Sensitive Developments (NSDs) were initially identified using Google Earth®, supported by a site visit to confirm the status of the identified dwellings.

The reason for the site visit, apart from sampling ambient sound levels, is that there could be a number of derelict or abandoned dwellings that could be seen as a sensitive receptor, or small dwellings that could not be identified on the aerial image, or those that were built after the date of the aerial photograph.

Potential receptors in and around the proposed wind energy facility were identified and are presented in **Figure 11.13**. The locations of the PSRs are defined in the Noise study (**Appendix L**).

It should be noted that, apart from NSD07, no other NSD are situated closer than 1,200 meters from the closest wind turbines (for all three phases). It should be noted that NSD05, 06 and 10 is derelict buildings. and therefore is no considered a NSDs.

Figure 11.13: Aerial image indicating potential noise sensitive receptors and property boundaries in the proposed Great Karoo Wind Farm (Phase 3)

11.7.2 Noise from Construction activities

Noise sources during construction include the following:

» **Construction equipment**
Construction equipment likely to be required will typically include excavator/graders, bulldozers, dump trucks, vibratory roller, bucket loader, rock breaker(s), drill rig, flat-bed truck(s), pile drivers, concrete trucks, cranes, fork lift(s) and various 4WD and service vehicles. Octave sound power levels typical for this equipment are presented in the Noise report.

» **Blasting**
Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. However, blasting will not be considered during the EIA phase for the following reasons:
  * Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use the minimum explosives and will occur in a controlled manner. The breaking of obstacles with explosives is also a specialized field and when correct techniques are used, causes significantly less noise than using a rock-breaker.
  * People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. However, these are normally associated with close proximity mining/quarrying.
  * Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties generally receive sufficient notice (siren) and the knowledge that the duration of the siren noise as well as the blast will be over relative fast results in a higher acceptance of the noise. Note that with the selection of explosives and blasting methods, noise levels from blasting is relatively easy to control

» **Traffic due to construction vehicles**
A source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the wind turbine. Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to additional traffic will be estimated using the methods stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise).

11.7.2.1 Results of Noise Modelling – Construction Noise

Only the calculated day time ambient noise levels are presented, as construction activities that might impact on sensitive receptors should be limited to the 06:00 – 22:00 time period. The worst-case scenario is presented with the entire activities taking place simultaneously during wind-still conditions, in good sound propagation conditions (20^{o}C and 80% humidity).

Even though construction activities are projected to take place only during day time, it might be required at times that construction activities take place during the night (particularly for a large project). Below is a list (and reasons) of construction activities that might occur during night time:

- Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
- Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore it is hard to judge beforehand if a construction team would be required to work late at night.

As it is unknown where the different activities may take place, it was selected to model the impact of the noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise impact) at all locations where wind turbines may be erected, calculating how this may impact on potential noise-sensitive developments as well as mapping this modelled construction activity over distance. Noise created due to linear activities (roads) were also evaluated and plotted against distance as illustrated below.

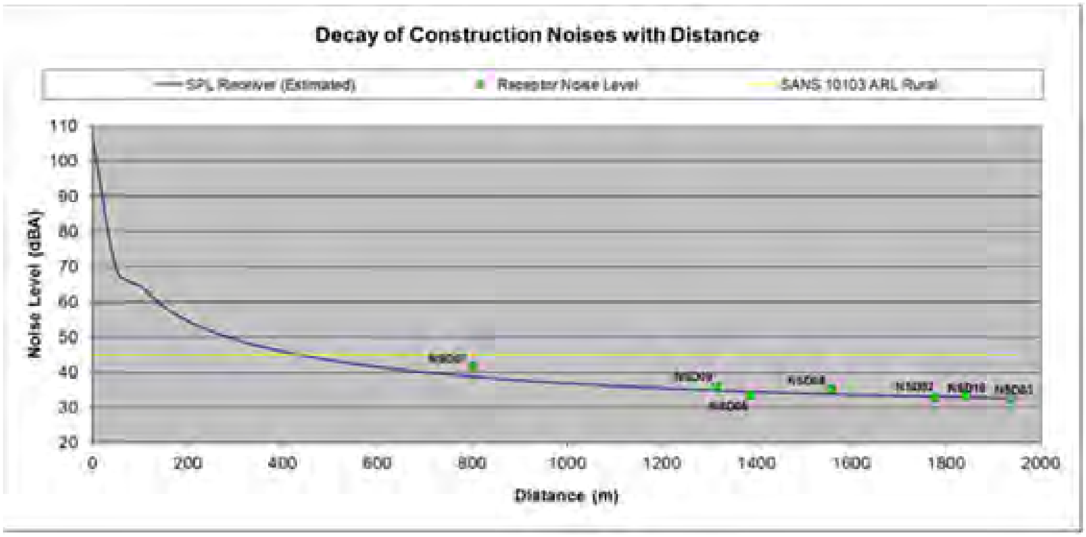

Figure 11.14: Construction noise: Projected Construction Noise Levels as distances increase between NSDs and locations where construction can take place

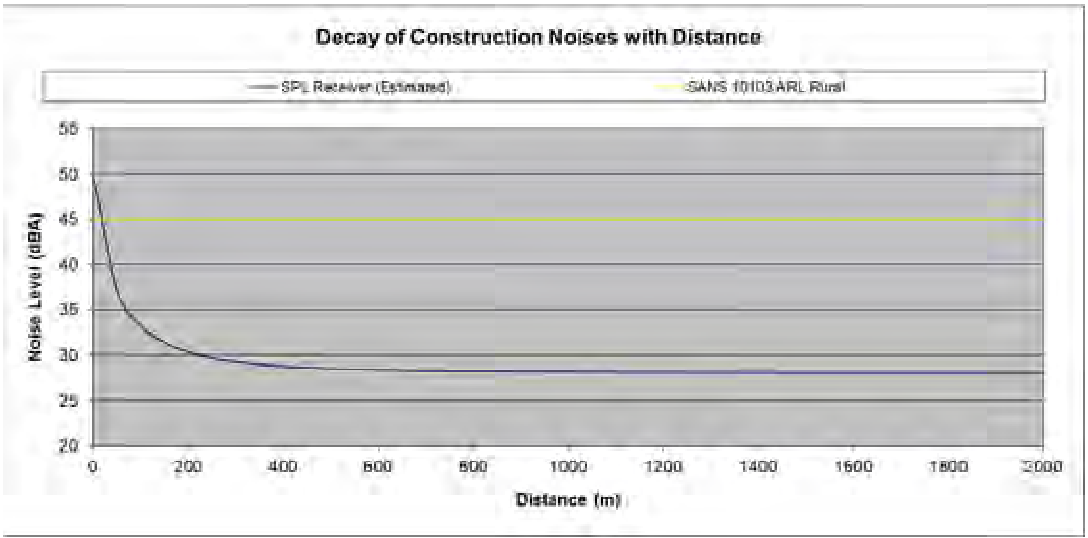

Figure 11.15: Construction noise: Projected Road Traffic Noise Levels as distances increase between NSDs and access roads (5 LDV and 5x Trucks travelling at 50 km/hr on a gravel road)

11.7.2.2 Impact tables summarising the significance of noise impacts (with and without mitigation) during Construction

Nature: Numerous simultaneous construction activities that could impact on PSRs.	
Acceptable Rating Level	Rural district with little road traffic: 45 dBA outside during day. Us of $L_{Req,d}$ of 45 dBA for rural areas.
Extent ($\Delta L_{Aeq,d}$>7dBA)	**Regional** – Change in ambient sound levels would extend further than 1,000 meters from activity **(3).**
Duration	**Temporary –** *Noisy activities in the vicinity of the receptors would last a portion of the construction period* **(1).**
Magnitude	**Low (2).**
Probability	**Improbable (1).**
Significance	**Low (10)**
Status	Negative.
Reversibility	High
Irreplaceable loss of resources?	Not relevant.
Can impacts be mitigated?	Yes, though mitigation not required.
Mitigation:	The following mitigation may be used: » Ensure a good working relationship between the developer and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potential sensitive receptor(s) include: o Proposed working times; o how long the activity is anticipated to take place; o what is being done, or why the activity is taking place; o contact details of a responsible person where any complaints can be lodged should there be an issue of concern. » When working near (within 500 meters – potential construction of access roads and trenches) to a potential sensitive receptor(s), limit the number of simultaneous activities to the minimum as far as possible; » When working near to potentially sensitive receptors, coordinate the working time with periods when the receptors are not at home where possible. » Potential receptors are most likely at school or at work, minimizing the probability of an impact happening; » Normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening.

	» Technical solutions to reduce the noise impact during the construction phase include: o Using the smallest/quietest equipment for the particular purpose. For modelling purposes the noise emission characteristics of large earth-moving equipment (typically of mining operations) were used, that would most likely over-estimate the noise levels. The use of smaller equipment therefore would have a significantly lower noise impact; o Ensuring that equipment is well-maintained and fitted with the correct and appropriate noise abatement measures.
Cumulative impacts:	This impact is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area.
Residual Impacts:	This impact will only disappear once construction activities cease.

11.7.3 Noise Sources: Operational Phase

Noise emitted by wind turbines can be associated with two types of noise sources:

» Aerodynamic sources: due to the passage of air over the wind turbine blades; and
» Mechanical sources that are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc. These sources generally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the substations themselves, traffic (maintenance) as well as transmission line noise.

» **Noise from the Wind Turbines: Aerodynamic sources24**

Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:

- o Self noise due to the interaction of the turbulent boundary layer with the blade trailing edge
- o Noise due to inflow turbulence (turbulence in the wind interacting with the blades)
- o Discrete frequency noise due to trailing edge thickness
- o Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade)

[24] *Renewable Energy Research Laboratory, 2006; ETSU R97: 1996*

- Noise generated by the rotor tips

These types of noise are discussed in more detail in the Noise Impact Assessment report contained in Appendix L.

11.7.5.1 Results of Noise Modelling – Operational Phase for Great Karoo Wind Farm

The Noise study focuses on the impacts on the surrounding sound environment during times when a quiet environment is highly desirable. Noise limits are therefore appropriate for the most noise-sensitive activity, such as sleeping, or areas used for relaxation or other activities (places of worship, school, etc.).

Appropriate Zone Sound Levels are therefore important, yet it has been shown that the SANS recommended (fixed) Night Rating Level ($L_{Req,N}$ = 35dBA) might be inappropriate due to the increased ambient sounds relating to wind action. A more appropriate method to determine the potential noise impact would be to make use of the projected noise levels due to the operation of the wind energy facility as well as the likely ambient sound levels due to wind induced noises.

Based on the preceding figures it is obvious that the risk of a noise impact developing is very low. The operation of the Great Karoo Wind Farm will not have a noise impact on any of the current noise-sensitive developments.

However, as can be seen from the preceding figures, the only risk of a noise impact is at NSD07. The operation of the Great Karoo Wind Farm would increase the existing ambient sound levels to a point where the increase would be detectable by this NSD. The changes in ambient sound levels is not yet of any significance (between 3 and 4 dB).

The noise levels at the other NSDs would be below the SANS recommended fixed noise level of 35 dBA at all wind speeds. The risk of a noise impact developing is low and the operation of the Great Karoo Wind Farm will therefore only have a slight impact on NSD07. The change in ambient sound levels is illustrated in **Figure 11.16.**

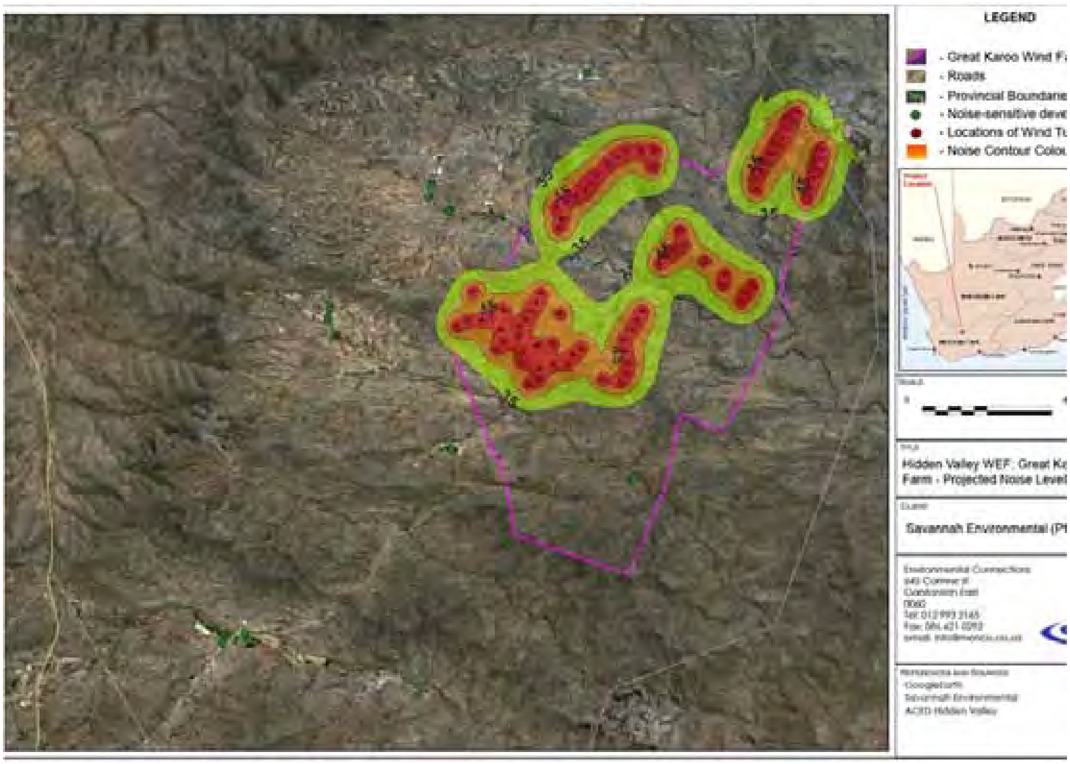

Figure 11.16: Projected Noise Levels (ISO model) from Great Karoo wind turbines; Contours of constant sound levels for a 5 m/s wind (WTGs marked as red dots, PSRs as green dots)

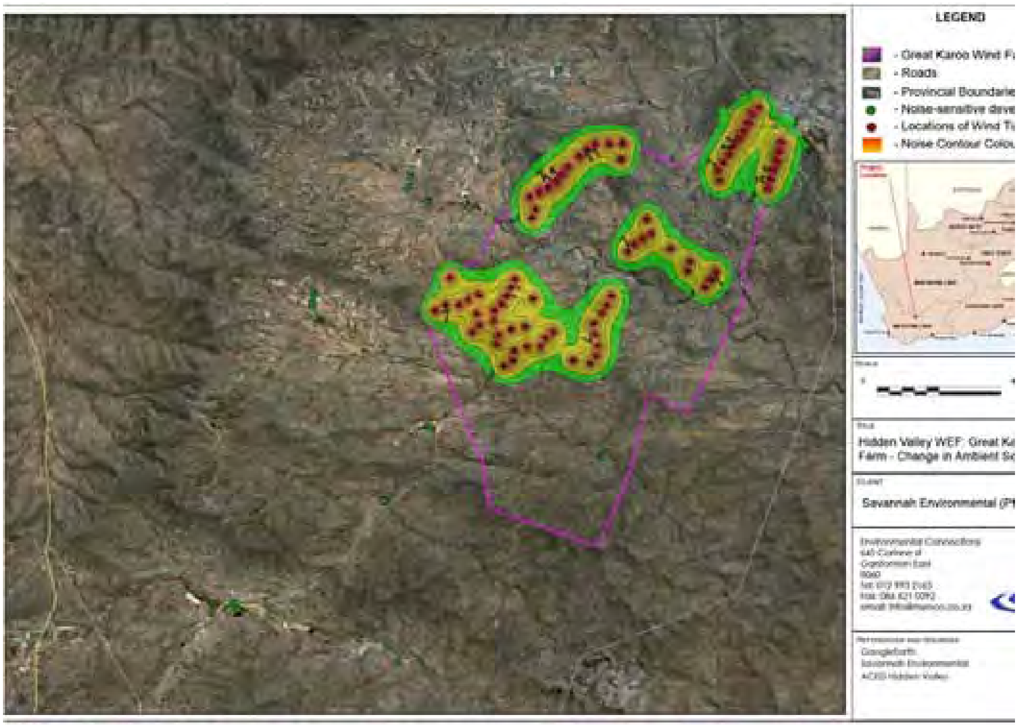

Figure 11.17 Change in ambient sound levels (ISO model), contours of constant noise levels for a 5 m/s wind (turbines marked as red dots, NSDs as green dots)

11.7.5.2 Impact tables summarising the significance of noise impacts (with and without mitigation) from the wind turbines – operational phase

Nature: Numerous turbines operating simultaneously during a period when a quiet environment is desirable.	
Acceptable Rating Level	Rural district with little road traffic. Refer to **Error! Reference source not found.** for the proposed Night Rating Level that varies with wind speed.
Extent ($\Delta L_{Aeq,n}$>7dBA)	Local – Impact will extend less than 1,000 meters from activity. (2).
Duration	Long – Facility will operate for a number of years (4).
Magnitude	Low (2) – for all current NSD
Probability	Improbable (1) for all current NSD
Significance	***8 (Low) for all current NSD using the Vestas V90 3.0 MW turbine***
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Can impacts be mitigated?	No noise impact, mitigation not required
Mitigation:	No mitigation required.
Cumulative impacts:	This impact is cumulative with existing ambient background noises.
Residual Impacts:	This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.

11.7.4 Comparative Assessment of Grid Connection Options

There will be no differences in the significance of noise impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a noise perspective.

11.7.5. Cumulative impacts

The section specifically looks at the potential cumulative noise impact with all three phases operational (Karusa, Soetwater and Great Karoo Wind Farms). The wind turbine used for the modelling is the Vestas V90 3.0MW turbine (operating in mode 0) with the relevant octave sound power levels. A wind rose obtained from the developer indicates that the wind direction is predominantly north-west. Additional modelling will therefore be done for this wind speed using the Concawe model.

Cumulative projected Noise Levels in the area due to the operation of the entire Hidden Valley Wind Energy Facility are illustrated in the figures below (ISO model for a 5 m/s wind).

Figure 11.18 illustrates the projected cumulative noise levels due to the operation of the proposed Hidden Valley Wind Energy Facility with all three wind farms operating, with **Figure 11.19** illustrating how these operating wind farms may alter the environmental ambient sound levels.

Those figures only illustrate and evaluate the potential noise impact for a 5 m/s wind speed. A more appropriate method to determine the potential noise impact would be to make use of the projected noise levels due to the operation of the wind energy facility for all wind speeds as illustrated in **Figures 11.20 and 11.21.**

Using the model parameters as outlined in the noise report, the following can be concluded:

» As was seen with the Great Karoo Wind Farm, the is a possible risk that the larger Hidden Valley wind energy facility may have a noise impact of a low-medium magnitude, mainly due to the distance to wind turbines 143 (804 meters) and 140 (948 meters).
» The operation of this wind energy facility will have no noise impact on any other NSD.
» With the input data as used, this assessment indicated that the cumulative operation of all wind turbines will have an ***insignificant noise impact***.

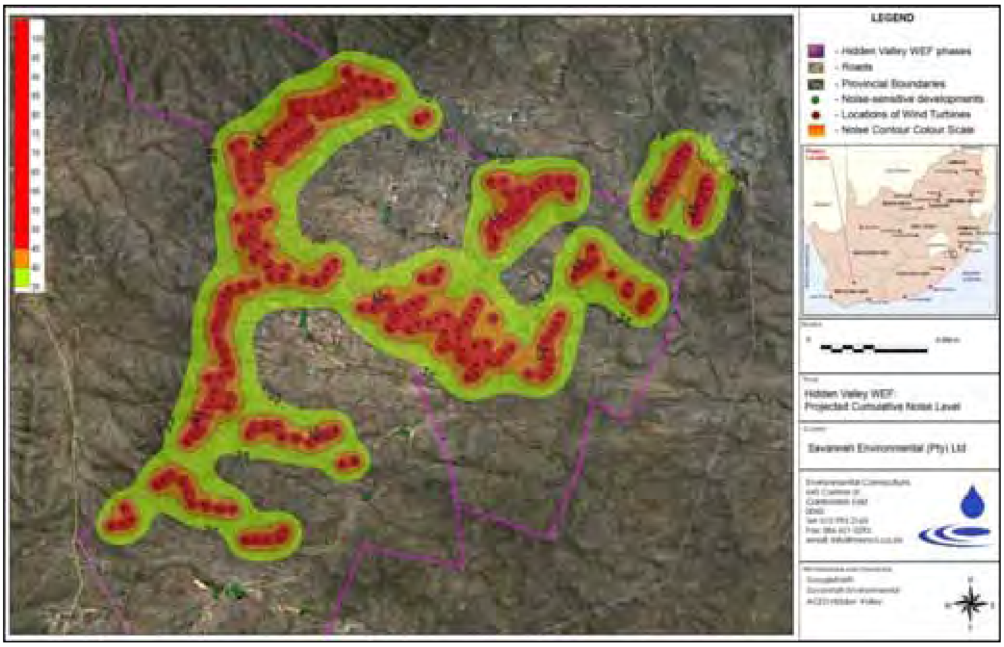

Figure 11.20: Projected Cumulative Noise Levels (ISO model) from Hidden Valley wind energy facility; Contours of constant sound levels for a 5 m/s wind

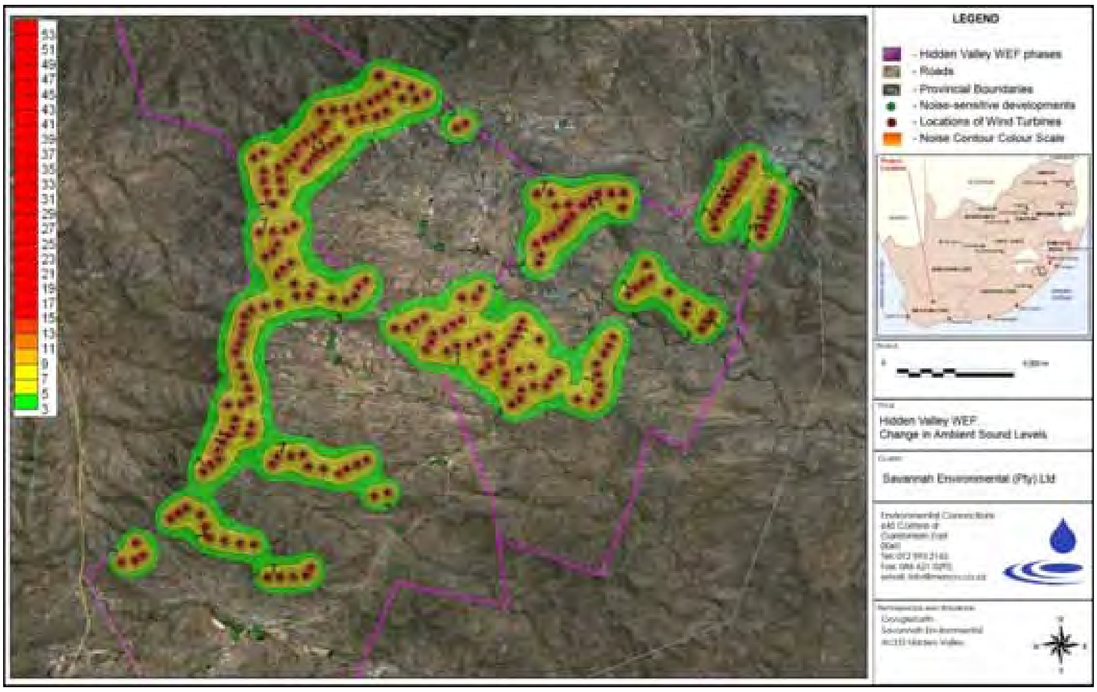

Figure.11.21: Projected change in ambient sound levels (ISO model); Contours of constant sound levels for a 5 m/s wind

Should the three other approved wind projects be developed, along with the Hidden Valley project, the cumulative impacts will have to be considered in a larger noise study, to be arranged by the relevant developers, as a joint effort, and based on final turbine layouts, as it is too difficult to predict at this stage.

11.7.9 Conclusions and Recommendations

By making use of predictive models to identify noise issues of concern, the noise assessment indicated that the proposed project will have a noise impact of low significance on all NSDs in the area during both the construction and operational phases using the Vestas V90 3.0MW wind turbine. However, mitigation measures are still proposed to reduce the potential noise impacts and risks to receptors.

With the input data as used, this assessment indicated that the proposed project will have a noise impact of a ***low significance*** on all current NSD in the area during both the construction and operational phases using the Vestas V90 3.0MW wind turbine for all wind speeds.

It should be noted that the noise impact was determined based on the outcome of a regression analysis that indicated that the likely long-term ambient sound levels could be significant during periods when wind speeds exceeds 4 m/s. The regression analysis is based on a number of measurements taken at various sites during periods when the wind was blowing, but when there were little other noise sources. As such it is recommended that the developer implement a monitoring programme before the development of the wind energy facility confirming the validity of the regression analysis of non-site specific data. It is therefore recommended that the ambient sound environment be defined over a longer period as per the environmental management programme.

In addition quarterly noise monitoring should be conducted by an acoustic consultant for the first year of operation. This monitoring is to take place over a period of 24 hours in 10 minute bins, with the resulting data co-ordinated with wind speeds as measured at a 10 meter height. These samples should be collected when the Wind Turbines are operational. Quarterly monitoring is recommended at NSD07 for the first year, as well as any other NSDs that have complained to the developer regarding noise originating from the facility.

Annual feedback regarding noise monitoring should be presented to all stakeholders and other Interested and Affected parties in the area. Noise monitoring must be continued as long as noise complaints are registered.

The findings of this report should also be made available to all potentially noise-sensitive developments in the area, or the contents explained to them to ensure that they understand all the potential risks that the development of a wind energy facility may have on them and their families.

With its potential for environmental and economic advantages, wind power generation has significant potential to become a large industry in South Africa. However, when wind farms are near to potential sensitive receptors, consideration must be given to ensuring a compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time the wind farms need to reach an optimal scale in terms of layout and number of units.

Wind turbines produce sound, primarily due to mechanical operations and aerodynamics effects at the blades. Modern wind turbine manufacturers have virtually eliminated the noise impact caused by mechanical sources and instituted measures to reduce the aerodynamic effects. But, as with many other activities, the wind turbines emit sound power levels at a level that can impact on areas at some distance away. When potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors.

It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source – but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels.

11.8 Assessment of Potential Impacts on Heritage - Archaeology

11.8.1 Impact of Construction on Pre-colonial Archaeology

The following heritage sites have been identified on the Great Karoo Wind Farm site and are shown in **Figure 11.22**:

- Dry Packed Stone Walling Kraal on the Farm Kentucky 206
- Two Graveyards on the Farm Kentucky 206
- Farmstead Complex on the Farm Kentucky 206

None of the proposed wind turbines occur on these heritage sites, and it recommended that associated infrastructure (such as access roads) avoid these heritage sites. The NHRA stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- Grade I: Heritage resources with qualities so exceptional that they are of special national significance;
- Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- Grade III: Other heritage resources worthy of conservation on a local authority level.

The occurrence of sites with a Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the applicable mitigation measures would allow the development activities to continue. **All the heritage sites below have been classified as Grade III sites.**

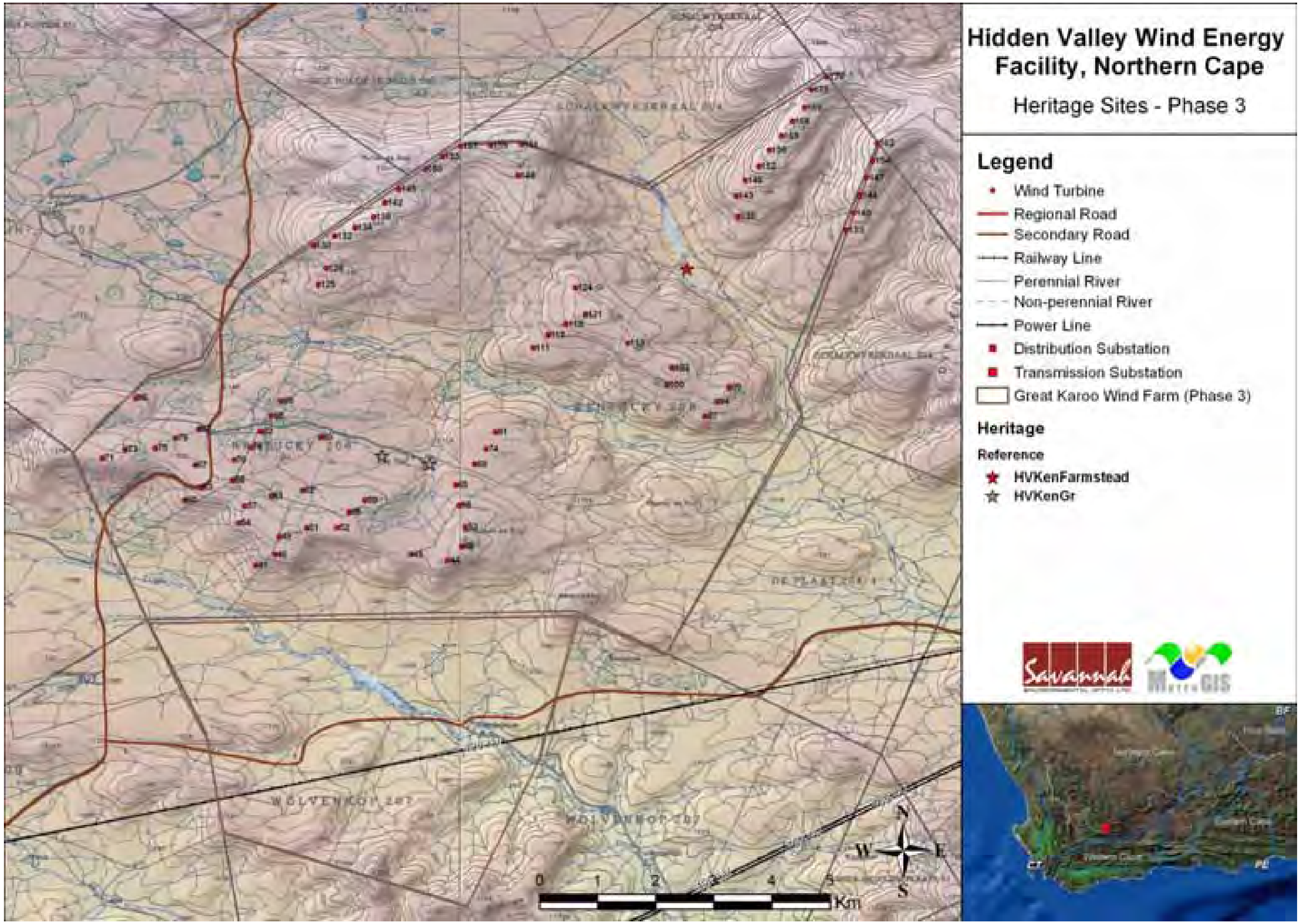

Figure 11.22: Grade III Heritage sites identified on the Great Karoo Wind Farm site

11.8.1.1 Impact Table – Impact of Construction on heritage artefacts

Nature: The destruction of identified heritage sites during the construction of the turbines, substation, cabling between the turbines, access roads and workshop.		
	Without mitigation	**With mitigation**
Extent	Local (5)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very High (10)	Moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (60**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	None	Low
Irreplaceable loss of resources?	Yes	Low
Can impacts be mitigated?	Yes	Yes
Mitigation: » A 10m perimeter boundary fence must be established around the identified sensitive heritage structures) before and during all construction and development activities. » If concentrations of archaeological materials are exposed during construction then all work must stop for an archaeologist to investigate. If any human remains (or any other concentrations of archaeological heritage material) are exposed during construction, all work must cease and it must be reported immediately to the nearest museum/archaeologist or to the South African Heritage Resources Agency, so that a systematic and professional investigation can be undertaken. Sufficient time should be allowed to investigate and to remove/collect such material. Recommendations will follow from the investigation.		
Cumulative impacts: » Irreplaceable loss of historical heritage resources.		
Residual impacts: » Irreplaceable loss of historical heritage resources.		

11.8.3 Comparative Assessment of Substation Options

There will be no differences in the significance of heritage impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a heritage impact perspective.

11.8.4. Cumulative impacts

There are heritage sites on all three development phases, therefore is these sites are destroyed during construction, there would a net increase in negative impacts on heritage artefacts. With mitigation, the impacts are of acceptable level. The same goes for the three other approved projects in the region.

11.8.5. Conclusions and Recommendations

No heritage sites occur within the development footprint of the proposed for infrastructure for the Great Karoo Wind Farm. However, historical archaeological remains, features and sites were documented and have been reported in the Phase 1 archaeological impact assessment (AIA). These sites occur in the broader farm portion. These remains, features and sites have been highlighted as they occur adjacent to the possible main access roads that will be used during the construction and development activities.

The site therefore has a medium-high cultural sensitivity according to the sensitive heritage remains, features, and site encountered, the following recommendations are made:

» A professional archaeologist (with an already authorised collection permit – if necessary) must be appointed during construction to monitor and identify possible archaeological material remains and features that may occur below the surface and make further appropriate recommendations on removing and / or protecting the archaeological material remains and features.
» If concentrations of archaeological heritage material and human remains are uncovered during construction, all work must cease immediately and be reported to the Albany Museum (046 622 2312) and/or the South African Heritage Resources Agency (SAHRA) (021 642 4502) so that systematic and professional investigation/ excavation can be undertaken.
» Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites.
» A 10m perimeter boundary fence must be established around the identified sensitive heritage structures adjacent to the farm gravel road before and during all construction and development activities.

11.9 Assessment of Potential Impacts on Palaeontology

11.9.1. Findings or Loss of Fossils during Construction

The construction phase of the wind energy facility will entail excavations into the superficial sediment cover (soils, etc.) and perhaps also into the underlying bedrock. These include excavations for the turbine foundations, buried cables, new internal access roads and foundations for associated infrastructure such as an on-site substation and workshop / administration building. In addition, sizeable areas of potentially fossiliferous bedrock may be sealed-in or sterilised by infrastructure such as hard standing areas for each wind turbine, lay down areas and internal access roads. All these developments may adversely affect potential fossil heritage within the study area by damaging, destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good. Once constructed, the operational and decommissioning phases of the wind energy facility will not involve further adverse impacts on palaeontological heritage.

The site is associated with continuous Permian-age sedimentary strata that cover large geographical areas, as well as more recent Quaternary- age alluvial and superficial valley fill deposits that occur as localized events. The area within which the wind energy facilities are to be constructed is primarily underlain by *in situ* strata of the fossil-bearing Abrahamskraal Formation (*Pa*). Quaternary alluvial deposits, especially near water courses and drainage lines, have the potential to yield microfossil and fossil mammal remains as well as Early Stone Age archaeological remains. The proposed development located within igneous bedrock (dolerite) represents no paleontological impact.

In general, the destruction, damage or disturbance out of context of fossils preserved at the ground surface or below ground that may occur during construction represents a negative impact that is limited to the development footprint. Such impacts can usually be mitigated but cannot be fully rectified (i.e. permanent). Because of the generally sparse occurrence of fossils within most of the formations concerned as well as within the overlying superficial sediments (soil, etc.), as inferred from better exposed localities elsewhere, the magnitude and probability of impacts are conservatively rated as low.

The overall impact significance of the construction phase of the proposed wind farm project is assessed as low (negative) without mitigation. It should be noted that, should fossils be discovered before or during construction and reported by the responsible ECO to the responsible heritage management authority (SAHRA) for professional recording and collection, as recommended here, the overall impact significance of the project would be further reduced. Residual negative impacts from any loss of fossil heritage would be partially offset by an improved palaeontological database as a direct result of appropriate mitigation. This is a positive outcome because any new, well-recorded and suitably curated fossil material from this palaeontologically under-recorded region would constitute a useful addition to our scientific understanding of the fossil heritage here.

The intent of mitigation and lessening of impact is to identify fossil localities for future avoidance or to recover in situ fossils before possible damage or destruction. However, effective mitigation of potential paleontological impact for this project is only feasible once the final positions of all individual structures and access roads have been finalised.

11.9.1.1 Impact Table – Impact on fossil heritage resources during the construction phase

Nature: Construction of the turbines, underground electrical grid, substation, associated building structures and access roads will impact on fossil-bearing sediments composed of Abrahamskraal Formation strata (Adelaide Subgroup). These sediments are regarded as of high overall paleontological significance, especially with regard to potential impact on vertebrate, invertebrate, plant and trace fossils. Late Quaternary alluvial and valley fill deposits in the area, especially near water courses and drainage lines, are of moderate overall paleontological significance and have the potential to yield fossil mammal remains as well as Early Stone Age artefacts. Potential paleontological heritage identified in the affected area could be negatively affected during the construction phase of the development.

	Without mitigation	**With mitigation**
Extent	Local High (5)	Local Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Moderate (6)
Probability	Probable (3)	improbable (2)
Significance	**Medium (50)**	**(Low) 24**
Status (positive or negative)	Negative	Positive
Reversibility	Improbable	Possibility
Irreplaceable loss of resources?	High	High
Can impacts be mitigated?	Yes	

Mitigation:

» Monitoring of areas where the concrete foundations for each turbine will be placed, where underground cables connecting the turbines with the substation will be placed, where the substation and office facilities will be constructed and where access roads will be located to provide access to each turbine site, **before** the commencement of development.

» 2) Monitoring of fresh exposures and bedrock excavations into the fossil-bearing strata **during** the construction phase of development.

11.9.2Comparative Assessment of Substation Alternatives

There will be no differences in the significance of fossil heritage impacts for any of the alternative substation or power line routings. Therefore any of the proposed alternatives are considered acceptable from a fossil impact perspective.

11.9.4. Cumulative impacts

The cumulative impact on fossils from the Great Karoo Wind Farm, and the other two phases, will not have a significant impact on palaeontology.

11.9.5. Conclusions and Recommendations

The proposed development located within igneous bedrock (dolerite) represents no major paleontological impact.

CONCLUSIONS AND RECOMMENDATIONS FOR PHASE 3 – GREAT KAROO WIND FARM CHAPTER 12

Great Karoo Wind Farm (Pty) Ltd is proposing to establish a commercial wind energy facility and associated infrastructure on a site located within the Karoo Hoogland Local Municipality. The site is located within the Karoo Hoogland Local Municipality (approximately 30 km south of Sutherland in the Northern Cape Province). ***This Chapter of the EIA report deals only with the conclusions and recommendations of the EIA for the Phase 3 of the larger "Hidden Valley Wind Energy Facility" referred to as the Great Karoo Wind Farm (DEA Reference Number 12/12/20/2370/3).***

The Great Karoo Wind Farm is proposed on the following farm portions (which collectively occupies land of 91.8 km^2 in extent):

» Farm Kentucky 206
» Portion 1 of Farm Wolvenkop 207

The primary components of the Great Karoo Wind Farm include the following:

» Up to 57[25] **wind turbines**, appropriately spaced to make use of the wind resource on the site. The facility is proposed to have a generating capacity of up to 150 MW, used depending on the final turbine selected for implementation but will be limited to 140MW at the point of connection with the Eskom grid. . The facility would be operated as a single facility with each turbine being between 2 MW and 3.5 MW in capacity.
» Each wind turbine is expected to consist of a concrete foundation (20m x 20m), a steel or concrete tower, a hub (between 80m and 120m above ground level, depending on the turbine size decided upon) and three blades with a rotor diameter of up to 120m.
» Cabling between the components, laid approximately 1 m underground where underground cabling feasible. In as far as possible, cabling will follow the internal access roads.
» Internal roads (approximately 8 m in width) linking the wind turbines and other infrastructure on the site. Existing farm roads will be used as far as possible. However, the dispersed distribution pattern of wind turbines and the vast areas of the site which are not currently accessible will necessitate the construction of ~30 km of new access roads in some areas.

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[25] Initially 77 wind turbines were proposed but this has been reduced to 57 in response to assessments and specialist recommendations

» A new 132 kV **substation** is proposed within this phase. The electricity from the 132 kV substation will be transmitted via a 132 kV **power line** to the 400 kV substation (located on the Phase 1 site) for connection to the Eskom grid. Two alternative substation locations and power lines are proposed.
» This proposed substation will have a high-voltage (HV) yard footprint of approximately 200m x 200 m.
» **Operations and service building area** for control, maintenance and storage (approximately 2000m^2).
» **Guard house** for access security of 50m$^{2.}$

The environmental impact assessment (EIA) for the proposed Great Karoo Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice 33306, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998) and the EIA Regulations of June 2010.

The EIA Phase aimed to achieve the following:

» Provide an overall assessment of the social and biophysical environments affected by the proposed development forward as part of the project.
» Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed wind energy facility.
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

The purpose of this amended Final EIA Report for the Hidden Valley Wind Energy Facility is to include the results, impact predictions and recommendations of the pre-construction bird and bat monitoring programmes as well as updating the project information where necessary.

12.1. Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices F - S provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the proposed project. This chapter concludes the EIA Report by providing a summary of the conclusions of the assessment of the proposed site for the wind energy facility and the associated infrastructure such as the substation and overhead power line. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental team during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project.

The assessment of potential environmental impacts presented in this report is based on a layout of the turbines and associated infrastructure provided by the developer. This layout includes 77 wind turbines as well as associated infrastructure. As mentioned, subsequent to the bird and bat monitoring surveys the turbine count has been reduced to 57 in response to assessments and specialist recommendations (this is discussed in detail in the Mitigation Section 12.5.1). No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However a number of impacts of medium to high significance were identified which require mitigation (thereafter the impacts can be reduced to medium – low significance). Mitigation to avoid impacts is primarily associated with the relocation (or in some instances, the elimination) of certain turbine positions of concern, as well as measures during the construction phase to prevent negative impacts from occurring. Removal and relocation mitigation has been implemented. Mitigations are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental **Management Programme (EMPr)** included within **Appendix P**.

The sections which follow provide a summary of the most significant environmental impacts associated with the proposed project, as identified through the EIA.

12.2. Summary of All Impacts

As a summary of the potential impacts identified and assessed through the EIA process in terms of the preliminary layout of 57 turbines and associated infrastructure, Table 11.1 indicates the significance ratings for the potential biophysical, ecological, visual and social impacts.

As indicated in Chapter 3, the significance weightings for potential impact have been rated as follows:

- **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
- **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)

» **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

Table 11.1: Summary of potential impacts identified and assessed through the EIA process

Nature	Without mitigation	With mitigation
Impacts on Ecology		
Loss or fragmentation of indigenous natural vegetation	Medium	Medium
Impact on threatened plants	Medium	Medium
Impact on Wetlands	High	Low
Impact on threatened animals species / habitat	Low	Low
Alien vegetation growth due to disturbance	Medium	Low
Impacts on Avifauna		
Bird mortalities due to collisions with wind turbines	Medium	Medium
Impact on birds due to disturbance	Medium	Medium
Loss of avifauna habitat	Medium	Low
Electrocution/ collision of birds with the power line	Medium	Low
Impacts on Bats		
Bat mortalities due to direct blade impact or barotrauma during foraging	High	Low
Bat mortalities due to direct blade impact or barotrauma during migration	Medium	Low
Destruction of bat roosts during construction	Low	Low
Impacts on Soil, Land Use, Land Capability and Agricultural Potential		
Loss of land with high agricultural potential and land capability	Low	Low
Soil Erosion / degradation during Construction	Medium	Low
Soil contamination / soil erosion during the operation of the facility	Low	Low
Social Impacts		
Creation of Employment and Business Opportunities during the Construction Phase	Medium	Medium
Impact of the presence of construction workers in the area on local communities	Low	Low
Risk of Stock theft and damage to farm infrastructure	Medium	Low

Increased risk of fires during construction	Medium	Low
Increases traffic on roads due to construction	Low	Low
Operational Phase -Creation of Long- Term employment and business opportunities	Low	Medium
Contribution of the project towards Development of Renewable Energy Infrastructure in South Africa	Medium	Medium
Long-Term Impact of the project on Existing Farming Activities on the Site	Low	Low
Impact of the wind energy facility on tourism in the region	Medium	Medium
Health Impacts due to the Operation of the wind energy facility	Low	Low
Visual Impacts		
Change in visual character and sense of place	Moderate	N/A
Visual impact of lighting at night on visual receptors in close proximity to the proposed facility	Medium	Medium
Shadow Flicker	Low	Low
Noise Impacts		
Noise impacts due to construction activities	Low	Low
Noise impacts from the wind turbines – operational phase	Low	Low
Impacts on Heritage Artefacts		
Impact of construction on pre-colonial archaeology	Medium	Low
Potential Impacts on Palaeontology		
Findings or Loss of Fossils during Construction	Medium	Low

12.2.1. Quantification of Areas of Disturbance on the Site

Site-specific impacts associated with the construction and operation of the proposed wind energy facility relate to the direct loss of vegetation and species of special concern, disturbance of animals and loss of habitat and impacts on soils. A wind energy facility is, however, dissimilar to other power generation facilities in that it does not result in whole-scale disturbance to a site. A site of 195.3 km^2 was considered for the facility, of which less than 1 % will be utilised for the wind energy facility. The bulk of this effective area required for the facility footprint would not suffer any level of disturbance as a result of the required activities on site. This is explained further below.

Permanently affected areas comprise 57 turbine footprints (57 foundation areas of 20m x 20m), access roads (up to 8 m in width), one 132 kV substation footprint (200m x 200 m) and an operations and service building area (200m^2). The area of permanent disturbance is approximated as follows:

Facility component - permanent	**Approximate area/extent (in m^2)**
57 turbine footprints (each circa 20m x 20m)	22 800
Permanent access roads within the site (8 m in width)	150 000
One on-substation complex footprint (circa 200m x 200 m)	40 000
Operations and service building area (circa 50m x 240m)	12 000
TOTAL	224800 m^2 (of a total area of 91 800 000 m^2) **i.e. 0.3% of site**

Temporarily affected areas comprise 57 foundation areas, laydown areas for turbines (each laydown area assumed to have a footprint of 60 m x 60 m) and possibly a track of 11 m in width if a crawler crane is required to move across the site (i.e. an additional 6 m width to the permanent road of 8 m in width). The area of temporary disturbance is as follows:

Facility component - temporary	**Approximate area/extent (in m^2)**
57 turbine laydown areas (60 m x 60m)	205200
TOTAL	205200 (of a total area of 91 800 000 m^2) = **0.3 % of site**

Therefore, less than 1% of the entire site can be anticipated to be disturbed to some extent during the construction and operation of the Great Karoo Wind Farm.

12.3 Comparative Assessment of Layout Options for Grid Connection (Substation)

Note that the Great Karoo power lines connect via Phase 1 (Karusa) power lines and into Komsberg substation. The position of the substation (and the alternative power line) is related to the point of connection to the Eskom grid via the 132 kV substation). The two alternatives for gird connection are as follows:

- Great Karoo Substation and power line 1 Option 1 is 7 km in length and runs through from Farm 206 and 209 to the 400 kV substation (located on the Karusa site). Option1 is technically preferred.
- Great Karoo Option 2 is 8 km in length and runs through Farm 206, 207 and 209 until it reaches the 400 kV substation on Farm 209.

A comparative assessment of the two substation location and grid connection alternatives is summarised in **Table 11.2**. Based on the comparative assessment Substation 1 and power line 1 is slightly less sensitive than the alternative, therefore **substation and power line Option 1 is nominated as the preferred alternative from an environmental perspective.**

Table 11.2: Comparison of recommendations for Grid Connection Options

	Great Karoo Substation Option 1 and linked Power line Option 1 (Technically preferred)	Great Karoo Substation Option 2 (Alternative) and linked Power line Option 2
Ecology (Flora)	» **Both options are acceptable**. Both grid connection options traverse the "Meintjiesplaas" non-perennial stream Portion 1 of Farm Wolvenkop 207 However, due to the width of the power line servitude (132kv = 36m), this is a marginal impact. Both powerline and substation options occurs in areas of medium ecological sensitivity. Therefore both grid connection options will have a similar impact on the ecological environment. With the use of mitigation measures during construction, both grid connection options are acceptable, with no preference from an ecological perspective.	
Avifauna	» Power line Option 1 is 7 km in length and connects Substation Option 1. » Of the 2 grid connection options, **Option 1 is slightly preferred** as option 2 crosses more than one small farm dam. » However, both options may be considered, if avifauna collision mitigation is used, i.e. "bird flight diverters" are fitted to the sections of line which have been mapped as either high and medium avifaunal sensitivity and as verified by a avifaunal "walkthrough" survey during the detailed design of the power line.	» Power line Option 2 is 8 km in length and connects to Substation Option 2. » Option 2 less preferred as it crosses near two farm dams (which have been buffered due to bird habitat) and may provide habitat for sensitive bird species.
Bats	» No preference	» No Preference
Soils	» The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation alternatives in terms of impacts of soils or geology. » The soil types and the steep erosion sensitive slopes are similar for both substation options. There are no major differences in the significance of impacts for either of the proposed substation alternatives in terms of impacts of soils or geology.	
Social	» No preference applicable in terms of social impacts, therefore both substation options are acceptable.	
Visual	» There will be no differences in the significance of visual impacts for any of the alternative substations. This is because the region in which the site is located is sparsely populated, with large distances between one homestead and the next. Furthermore, the visual landscape is already disturbed with the current 400 kV substation on the site as well as power lines.. Therefore either of the proposed alternatives are considered acceptable from a visual impact perspective.	
Noise	» There will be no differences in the significance of noise impacts for any of the alternative substation or power line routings. Both substations are further than 200m from noise receptors, therefore both options are acceptable in terms of transformer noise.	
Heritage	» Both substation options occur outside of the heritage sites and are therefore both acceptable from a heritage point of view.	
Palaeontology	» No preference between the alternatives.	

12.4 Cumulative Impacts

Based on the information available at the time of undertaking the EIA, there are other wind energy facilities are proposed in the immediate region. These are listed in Table 11.2. Four authorised wind energy facilities are proposed in the immediate study area.

None of the above-mentioned projects have preferred bidders status at the time of writing this EIA report. 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 be developed. It is considered that not all proposed developments will be granted the relevant permits by the relevant authorities (DEA, DoE, NERSA and Eskom) and this is because of the following reasons:

» There are limitations to the capacity of the existing Eskom grid.
» Not all applications will receive positive environmental authorisation.
» There are stringent requirements to be met by applicants.
» Not all proposed wind farms will be viable because of the wind resource.
» Not all wind farms will be able to reduce negative impacts to acceptable levels or able to mitigate adequately.
» Not all proposed wind farms may be granted a generation license by NERSA and sign a Power Purchase Agreement with Eskom.

There are currently no existing commercial wind farms or preffered bidder wind projects in the vicinity of the Hidden Valley site both on the Northern Cape and Western Cape side of the provincial boundary.

Table 12.2: Proposed wind farm developments in the vicinity of the Hidden Valley Site

Wind Farm (Developer)	No. of turbines	Distance (km)	Status of the development	DEA Reference Number
27. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Roggeveld	Authorisation received	12/12/20/1783
28. Witberg Wind	Up to 27	Approx. 25km	Authorisatio	12/12/20/1966

Farm (G7 Renewable Energies)		south of Roggeveld	n received	
29. Sutherland (wind and solar) (Mainstream SA)	293 to 386	Approx 35km north east o/f Roggeveld	Authorisation received	12/12/20/1782
30. Suurplaat Wind Farm 31. (Moyeng Energy)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received	12/12/20/1583
32. Roggeveld Wind Farm	Approximately 207	Adjacent to the Hidden Valley site (to the west)	EIA in process	12/12/20/1988/1-3
33. Gunstfontein	Approximately 100	Adjacent to the Hidden Valley site (to the north)	EIA in process	14/12 /16/3/3/2/399 (wind) 14/12/16/3/3/2/395 (solar)

The combined effect of the various wind farms proposed for this area will have a cumulative visual impact and impact on the landscape character. The significance of this cumulative impact is uncertain as at the time the assessment was undertaken the details of the final layouts of adjacent or neighbouring facilities were not available and could therefore not be quantitatively assessed. Cumulative impacts discussed below and have been considered within the detailed specialist studies, where applicable (refer to Appendices F - S):

The potential ***direct cumulative impacts*** as a result of the proposed project are expected to be associated predominantly with:

» *Visual impact* - This impact may be sequential and additive, due to the visibility of wind turbines from three or more within 10-20 km of each other. From a visual perspective, the overlapping viewsheds can be considered favourable, as it represents the consolidation and concentration of potential visual impacts within a clustered region (i.e. the development of a wind energy facility node, rather than dispersing the impact to other areas). In addition, this region of the Karoo is sparsely populated, with large distances between one farmstead and the next and between one town and the next.
» *Social* (linked to visual) - The establishment of four or more wind energy facilities in the area may impact negatively on the landscape and the areas rural sense of place and character. The cumulative impact will however to some extent be moderate due to the relatively low incidence of visual receptors in the region. On the other hand, cumulative positive socio-

economic impacts from three or more wind energy facilities in terms of job creation and economic growth and development of infrastructure will occur in a local and district municipality that is in need of this growth and development, may be significant.

» *Impact on SALT – The intensity of light generated by the wind energy facility is* expected to be of a lower order than that generated by the urban area of Sutherland due to the dispersed nature of the turbines. The distance of the SALT from the wind energy facility and the elevated position of the SALT reduce the significance of this impact to insignificant. The furthest extent of direct visibility of turbine hubs and lights in the direction (NE) of the SALT is 10km. The project may impact on (due to lighting) the day-to-day operations of the observatory. However, approval of the Hidden Valley wind project will be contingent on the developer's ability to prove that the facility will not contravene the provisions of the Astronomy Geographic Advantage (AGA) Act (2007).

The potential ***indirect cumulative impacts*** as a result of the proposed project are expected to be associated predominantly with:

» *Flora, fauna, and ecological processes* - (impacts that cause loss of habitat may exacerbate the impact of the proposed facility impact) at a regional level driven mostly by the possibility of other similar facilities being under construction simultaneously. Impacts related to disturbance, habitat loss and collision related mortality of avifauna may become cumulative if other wind energy facilities are developed in the region. Should the Hidden Valley project and the three other above-mentioned proposed wind projects in the Karoo region be developed, cumulative negative ecological impacts may occur. The significance of this impact is expected to be of a moderate significance and can result in a cumulative loss of biodiversity (particularly for protected plants and animal species and soil erosion). However, if negative impacts on ecology is effectively mitigated and managed for each project, through sound environmental management during construction and operation and by formal conservation and active management of the natural areas on site, then the negative impacts on ecosystems on each site can be within acceptable levels, and therefore in keeping with the principles of sustainable development. With the implementation of good environmental management practise during the life cycle of each project, cumulative impacts on ecology as a result of the establishment of various wind energy facilities in the area could be of an acceptable level.
» *Avifauna* - The cumulative effect of the four or more wind energy facilities on bird species of conservation concern may be moderate to high, without mitigation. It is, therefore, imperative that pre-construction and post-construction monitoring is implemented on each site using any accepted or

endorsed bird monitoring guidelines or standards to provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. Turbines should be carefully placed outside of sensitive areas as is the case on the Great Karoo Wind Farm. This will provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species. At this stage, indications are that displacement may emerge as a significant impact, particularly for target species.Furthermore, when viewed in isolation, one wind energy facility may pose only a limited threat to the avifauna of the region. However, in combination they 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 repeated arrays of turbines spread across foraging areas and/or flight paths of priority species.

- *Bats*: Cumulative impacts on bats due to multiple wind energy facilities in the region will be of a medium significance if project specific mitigations are implemented for each project.
- *Cumulative geology, soil and erosion potential* - although the impact of soil removal for the proposed activity has a moderate – low significance, the cumulative impact of soil removal in the area is considered low due to undeveloped nature of the area. The cumulative impact of soil pollution in the area is considered moderate. The cumulative impact of siltation and dust in the area is considered low, with the legal obligation of good soil management for each project.
- *Cumulative noise impacts* - the impact of numerous simultaneous construction and operational activities that could affect potential sensitive receptors is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area. The potential for cumulative impacts is low.
- *Infrastructure* - Increased pressure on existing roads and other infrastructure may occur.
- *Heritage* –Cumulative changes to the pre-colonial cultural landscape in terms of visual impacts and changes to ‘sense of place’ will occur from various projects in the region. The potential for the loss or find of heritage artefacts in the Karoo region will also increase.

12.5 Environmental Sensitivity Mapping and Recommendations

From the specialist investigations undertaken for the proposed Karusa Wind Farm development site, a number of potentially sensitive areas were identified (refer to **Figure 12.1**) where walk-through surveys are required to be undertaken to confirm the final placement of turbines and other associated infrastructure within these areas (including substation complex, access roads and power line routes).

No absolute environmental 'no go' areas were identified on the site. However, the following sensitive areas have identified on the site:

» Vegetation of conservation importance: this is based primarily on the location of the site within the Hantam-Roggeveld Centre of Endemism and the Fynbos Biome and which falls within the Namakwa District Biodiversity Sector Plan (NDBSP), Critical Biodiversity Area (CBA) T2 (for this site - important terrestrial habitats that are **south-facing slopes** larger than 25 ha in size, kloofs and habitat for riverine rabbit, therefore with high biodiversity) (medium sensitivity). Areas classified as mountains, ridges or **steep slopes**: some of the steeper scarp slopes of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance and have been identified as important biodiversity habitats (essential T2 areas from the NDBSP) (high sensitivity).
» Potential areas for the occurrence of populations of Red List fauna and flora that have been evaluated as having a probability of occurring in **natural habitats** within the study area.
» Perennial and non-perennial rivers, streams and **watercourses**. These support the ecosystems in the areas and may provide habitat for priority avifauna species.
» Noise sensitive receptors (farmsteads on / around the site, albeit limited).
» Heritage artefacts (graves, stone walls and old buildings/ruins present on the site). (Note that no infrastructure is proposed on the identified heritage sites).
» Areas of high avifaunal sensitivity include rivers, streams, farm dams and slopes. Based on the results of the pre-construction bird monitoring (4) wind turbines (75, 76, 149 and 154) falls within the high risk areas for avifauna
» Areas of high bat sensitivity also include rivers, farm dams and slopes. One turbine (125) occurs in the moderate sensitivity buffer for bats.

Should mitigation measures be adhered to, impacts on the identified sensitive areas can be adequately managed.

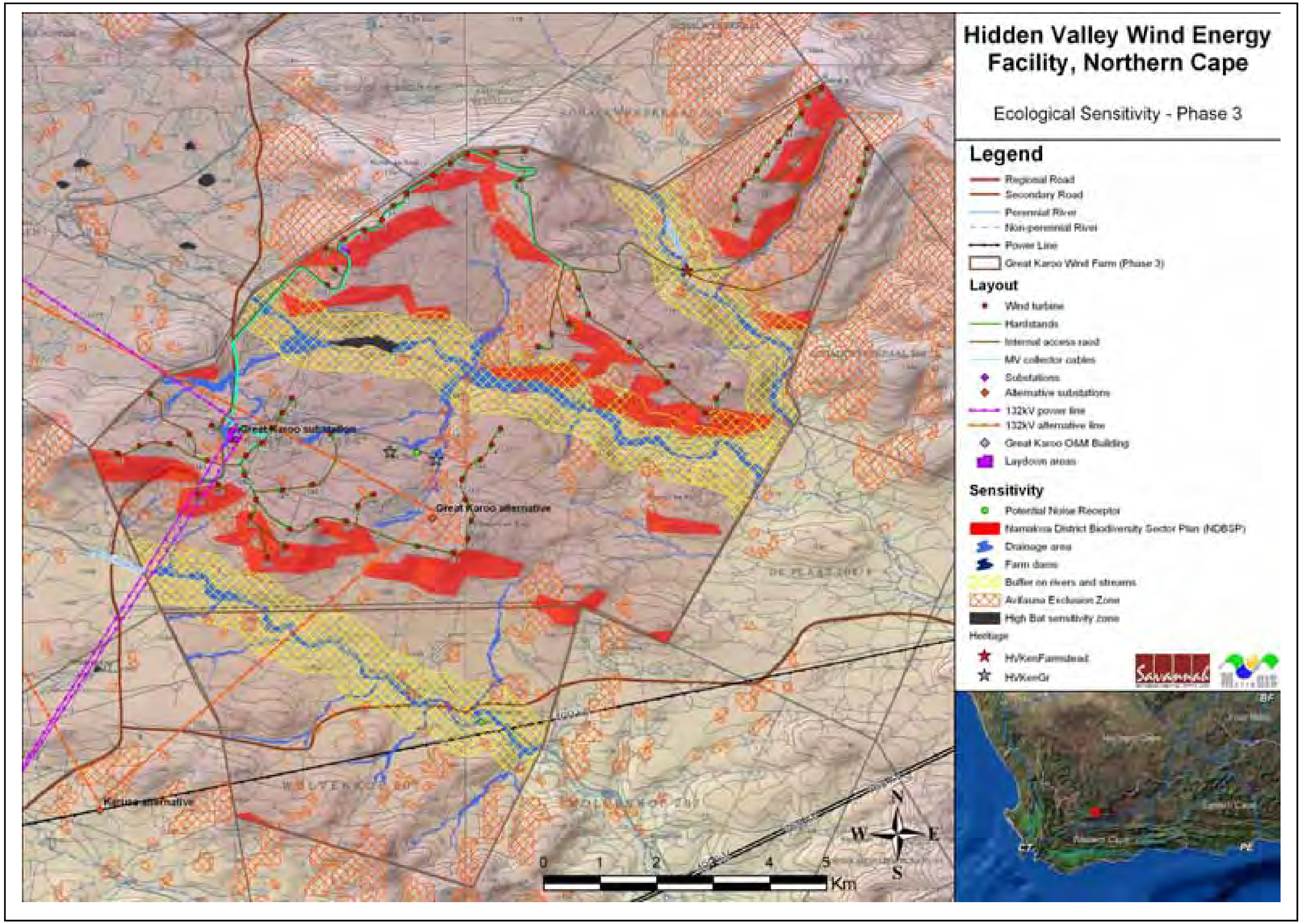

Figure 12.1: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the proposed Great Karoo Wind Farm development footprint

12.5.1. Mitigation Strategy

In response to the identified need to adequately manage impacts within sensitive areas identified on the site development footprint, and in order to demonstrate the ability of the project to adhere to recommended mitigation measures, the project developer has developed as a best practice mitigation strategy with regards to the facility layout.

The EIA recommendations have been taken into account by the project developer, and the wind turbine layout has been refined to avoid the areas identified as being of high sensitivity. This refinement of the layout has resulted in the removal of turbines from the layout completely and the repositioning of turbines outside of identified sensitive areas. This layout considering the required mitigation measures is included in Figure 12.2, and represents the optimal layout for the facility. This refined layout shows a change in wind turbines from 77 to 57.

The table below summarises which wind turbines have been moved out of sensitive areas, and which turbines have been removed from the layout.

Turbine Number - EIA-assessed layout for Phase 3	**Reason for repositioning of turbine**
75, 76, 149, 154,	Avifaunal risk – 4 wind turbines placed within a high risk area. Action: 4 turbines **removed** from the layout
125	Bat risk – One wind turbine occurred in a moderate bat sensitivity buffer area (movement not required but developer adhering to best practice) Action – one wind turbine was **removed** from the layout
151, 154, 157, 162	Bat risk – 4 wind turbines placed immediately outside of moderate bat sensitivity buffer (movement not required but developer adhering to best practice) Action: four wind turbines **removed** from the layout

The refined layout now has a reduced number of wind turbines for the Great Karoo Wind Farm site. The turbines have been reduced from 77 to 57. (i.e. 20 less turbines are proposed for construction within the Great Karoo Wind Farm).

Reflected in the revised map (Figure 12.2, a new logical numbering system has been applied to account for the reduction in turbine numbers and distinction between the three phases of the broader project. As is evident from the revised layout and sensitivity map (refer to Figure 12.2) the revised/optimised layout adheres to the mitigation strategy having no wind turbines located in environmentally sensitive areas. Other additional minor movements to turbines to uphold energy generation efficiency were also required in order to accommodate the revision of turbine positions around environmental exclusion zones. The revised layout responding to the mitigation measures was shared with the specialist team, and letters and assessment reports have been obtained (and appended to this amended FEIR) in support of the layout revision. It is confirmed by the specialists that the layout which responds to the mitigation strategy is environmentally acceptable, and either reduces the impacts as originally assessed, or the impact significance ratings remain unchanged.

Letters from specialists confirming the acceptability of the revised layout are attached as Appendix T. The optimised layout is considered to address the significant issues raised through the EIA process, and is supported by the EAP and EIA specialist team for Environmental Authorisation.

Planning of the positioning of infrastructure in this new layout has taken factors into account with respect to existing disturbance on site. Existing road infrastructure will be used as far as possible for providing access to proposed turbine positions. Where no road infrastructure exists, new roads should be placed within existing disturbed areas or environmental conditions must be taken into account to ensure the minimum amount of damage is caused to natural habitats and that the risk of erosion or downslope impacts are not increased. Road infrastructure and underground cable alignments should coincide as much as possible.

The developer must consider the mitigation measures proposed in the heritage impact assessment (Appendix J). Grave and burial areas must be identified and cordoned off before construction and an archaeologist should be appointed to inspect the exact and immediate surrounding area for possible sites once the final positions for the wind turbines and other infrastructure are known. An ECO should also be appointed during the construction phases to observe whether any depth of deposit and in situ archaeological material remains is uncovered. If at any stage during the construction phase any semblance of a fossil is observed, it would be necessary to stop the work immediately and report this occurrence to SAHRA and/or a professional palaeontologist.

The developer should consider the various mitigation options as suggested in the noise EIA assessment (Appendix K) to reduce the significance of the potential noise impact on any sensitive receptors to an impact of lower significance.

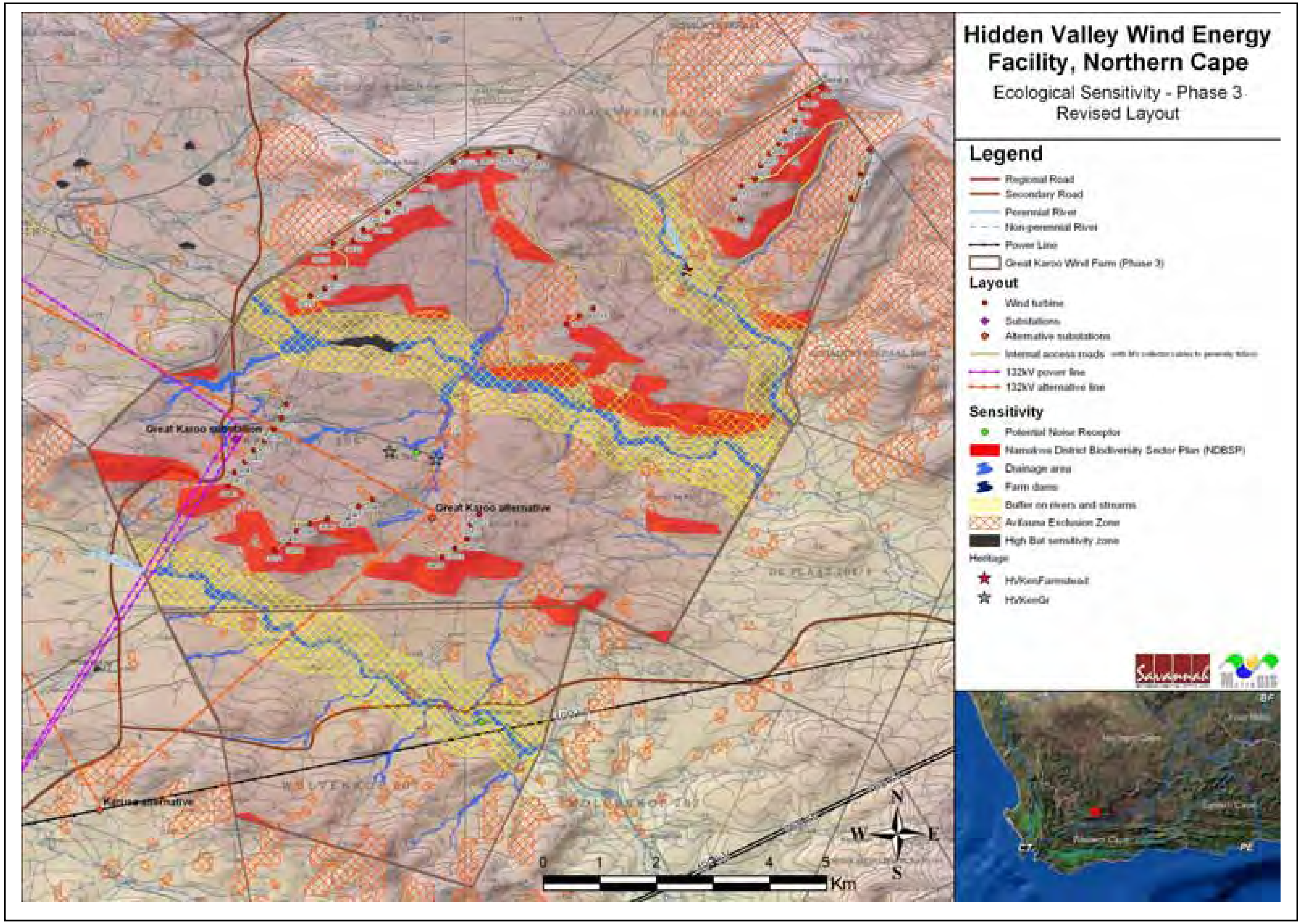

Figure 12.2: <u>Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the revised Great Karoo Wind Farm layout for DEA approval</u>

12.6 Overall Conclusion (Impact Statement)

Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of resources. In order to meet the long-term goal of a sustainable renewable energy industry in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation capacity being derived from renewable energy forms by 2030.

Through pre-feasibility assessments and research, the viability of establishing the Great Karoo Wind Farm, in the Northern Cape has been established by Great Karoo Wind Farm (Pty) Ltd. The positive implications of establishing a wind energy facility on the demarcated site include:

- » The project would assist the South African government in reaching their set targets for renewable energy.
- » The potential to harness and utilise good coastal wind energy resources on this site would be realised.
- » The National electricity grid in the Eastern Cape would benefit from the additional generated power.
- » Promotion of clean, renewable energy in South Africa.
- » Creation of local employment and business opportunities for the area.

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

- » There are **no environmental fatal flaws** that should prevent the proposed wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented.
- » The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures. With

reference to the information available at this planning approval stage in the project cycle, the **confidence** in the environmental assessment undertaken is regarded as **acceptable**.

12.7. Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the facility and associated substation and power line, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Great Karoo Wind Farm and associated infrastructure can and has been mitigated to an acceptable level, provided appropriate mitigation is implemented and adequate regard for the recommendations of this report and the associated specialist studies is taken during the final design of the project.

<u>The revised layout shown in Figure 12.2 is acceptable and the </u>following conditions would be required to be included within an authorisation issued for the project:

» All mitigation measures detailed within this report and the specialist reports contained within Appendices F to S must be implemented.
» The draft Environmental Management Programme (EMPr) as contained within Appendix P of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed wind energy facility, and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
» Following the final design of the facility, a revised layout must be submitted to DEA for review and approval prior to commencing with construction.
» Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect and quantify any alien species.
» A comprehensive search for threatened and near-threatened plant and animal populations must be undertaken within the footprint of the proposed infrastructure prior to construction, once the final position of infrastructure if known. For plants, this must take place during an appropriate season to maximise the likelihood of detecting plants of conservation concern. If any plants or animals of conservation concern are found within areas proposed for infrastructure, localised modifications in the position of infrastructure must be made (if possible) to avoid such populations and a suitable buffer zone around them applied, where applicable. Where it is not possible to relocate

infrastructure, a permit may be required to be obtained in terms of Chapter 7 of the National Environmental Management: Biodiversity Act to carry out a restricted activity involving a specimen of a listed threatened or protected species.

» Implement an operational phase monitoring programme to record the impact on bat species using the site.
» Implement an operational phase monitoring programme to record the impact on bird species using the site.
» Establish an on-going monitoring programme to detect, quantify and remove any alien plant species that may become established.
» Adequate stormwater management measures to be put in place as the soils on the site may be prone to erosion due to shallow profiles and steep slopes.
» Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads).
» Plan the road and site layout in such a way as to make maximal use of existing roads and fence/border areas to minimise impacts and to keep grazing and natural units as intact as possible.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.
» Use of fire prevention and fire management strategies for the wind energy facility, to reduce risks to landowners.
» Implement a noise monitoring programme before the development of the wind energy facility. If needs be, quarterly noise monitoring should be conducted by an acoustic consultant as long as noise complaints are registered.
» Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites (as detailed in the EMPr).
» The heritage artefacts identified in the EIA must be cordoned / protected prior to the start of construction, to ensure that heritage sites are not destroyed.
» Applications for all other relevant and required permits if required to be obtained by the developer or the construction contractor must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site, disturbance to heritage sites, disturbance of protected vegetation, and disturbance to any riparian vegetation or wetlands.

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