5 BIOPHYSICAL BASELINE

The environment consists of the entire complexity of interacting geological, biological, social, economic and cultural factors, which influence the lives of individuals and communities. It is thus essential that the effects of any proposed development on all aspects of the environment be assessed before a decision to proceed is taken. The environmental and social baseline conditions of the Study Area for this project are described briefly in this section while specialist studies will explore issues such as ornithology, vegetation, visual, heritage resources, noise and socio-economic considerations more fully and assess the impacts the proposed development may have on these aspects as part of the specialist studies and integration and assessment phases of the EIA.

5.1 BIOPHYSICAL BASELINE

This Section focuses on the biophysical components of the environment.

5.1.1 Climate

The Roggeveld site is located in the Karoo Highland region. The climate is arid to semi-arid, but temperatures are tempered by the altitude of the region. Rainfall occurs throughout the year although the peak seasons are autumn and winter. Mean annual precipitation is approximately 290 mm, ranging from 180 – 410 mm rainfall per year. The hottest month in the summer is January and the coldest month in the winter is July. The predominant wind direction is from the northwest. The incidence of frost is relatively high with between 20 to 50 frost days recorded per year.

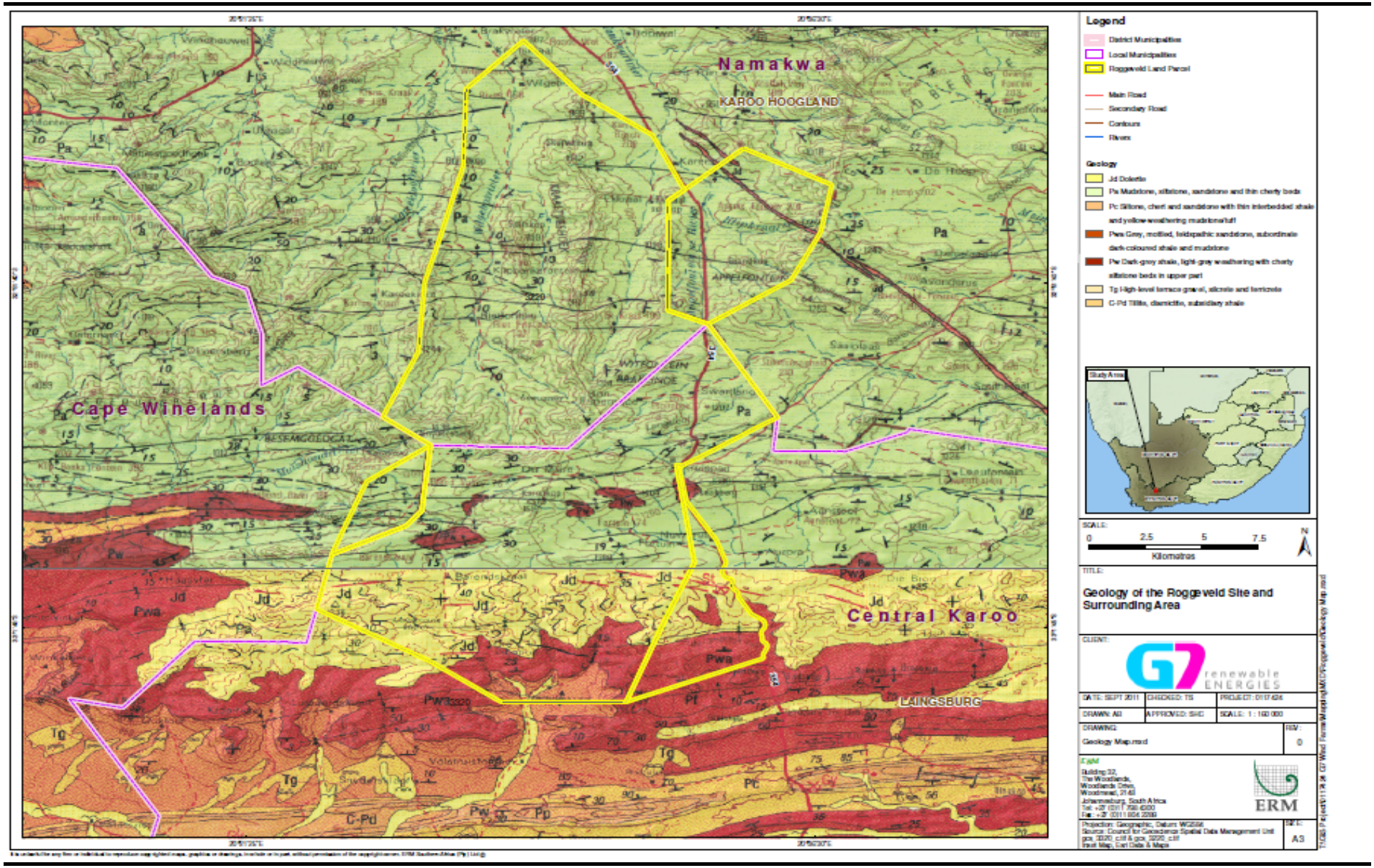
5.1.2 Topography

The highest point within the site is 1,450 m above sea level. The site area and surrounds feature a network of numerous hills, mountains and ridges, interspersed by valleys below the high ground, which are located at approximately 700 - 1,000 m above sea level. The dominant orientation of the ridges within the site area is north-south. A wider, open valley with undulating hills lies to the east of the site at approximately 1,000 – 1,200 m above sea level.

5.1.3 Geology and Soils

The site is underlain by the Adelaide Subgroup which forms part of the lower Beaufort Group and is Permian in age. This subgroup consists of fine grained sandstone and course arkose, alternating with green and brownish-red mudstone. Jurassic aged dolerite intrusions in the form of dykes and sills are also associated with this Subgroup. *Figure 5.1* below shows the slope and general topography of the site.

Figure 5.1 Geology map



5.1.4 Surface Water and Groundwater

The aquifer beneath the site is classified as a fractured aquifer which has a groundwater yield potential of between 0.5 to 2.0 l/s and electrical connectivity values vary between 20 to 795 mS/m. The aquifer is fractured and groundwater is associated with joints and fractures of dolerite contact zones with country rock, decomposed dolerite and zones of semi-weathered dolerite. The Department of Water Affairs and Forestry (1) classifies the regional aquifer as a major aquifer with moderate vulnerability (likelihood of contaminants reaching a receptor) and low susceptibility (potential significance of contaminants reaching a receptor).

Within the site area there are numerous small non-perennial watercourses that flow from areas of high ground into and along valleys within the site. Tributaries of two perennial rivers, the Wilgebosrivier and Furrowrivier flow from within the site area to beyond in the north and south of the site respectively. Other perennial watercourses that are located in the areas surrounding the site include the following:

- Kereekloofrivier (approximately 2 km west of site)
- Matjiesfontein se Kloof (approximately 5 km west of the site)
- Roggeveldrivier (approximately 5 km east of the site)

Given the size of the site and varied topography it is likely that the site is located within a number of different watersheds.

Within the site area and beyond there are a number of farm dams. To the east of the site, topography maps show a number of waterbodies which may be dams or non-perennial pans.

5.1.5 Flora and Fauna

The Roggeveld site is located in the Rain Shadow Karoo Bioregion. In this region the Succulent Karoo Biome overlaps in areas with the Fynbos Biome. The vegetation types found on and around the site are described below.

Central Mountain Shale Renosterveld occurs predominantly on the southern portion of the site. Hill slopes and broad ridges support tall shrubland dominated by renosterbos and non-succlent Karoo shrubs. Geophytic flora occurs in more open, wetter, rocky habitats. This vegetation type is considered to be least threatened (Rouget *et al*. 2004).

Koedoesberge-Moordenaars Karoo occurs in a broad area of the Karoo, predominantly on the northern portion of the site. Low succulent scrub with scattered tall shrub and patches of 'white' grass typify this vegetation type, and it is considered to be least threatened (Rouget *et al*. 2004).

(1) Department of Water Affairs and Forestry. (1999) Aquifer Classification of South Africa, 1: 3 000 000.

During the site visit, it was confirmed that the habitats of the site and surrounds are dominated by open Karoo shrub land. Based on initial site investigations the site is considered to be a suitable foraging site for birds of prey which are known to use ridges and escarpments (and their associated wind conditions such as updrafts) for soaring flight activities during hunting and territorial display. The valley and lower ground within the site are likely to support breeding and foraging birds and small mammals such as buck. Lower-lying areas of the site are considered to be suitable foraging habitats for bats.

The ecological sensitivity map of the site is depicted in *Figure 5.1.*

The majority (80%) of turbines are located within the Central Mountain Shale Renosterveld and about 20% within Koedoesberge-Moordenaars Karoo. Although these vegetation types are not well protected within formal conservation areas, they have not been highly impacted by intensive agriculture and both Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld are 99% intact.

The site straddles the planning domain of two different Biodiversity Assessments. Those parts of the site within the Western Cape fall within the *Biodiversity Assessment of the Central Karoo District Municipality* (Skowno et al. 2009). While those parts of the site which lie within the Northern Cape fall within the *Namakwa District Biodiversity Sector Plan* (Desment & Marsh 2008).

The following issues need to be taken into account when considering development within a CBA:

- Are there alternative areas within the site but outside of the CBA that could be developed?
- Does the project undermine the overall ecological functioning of the broad CBA area?
- Can mitigation measures reduce the impact of the development on ecological processes?

In terms of the first issue listed above, this is largely outside the scope of this study as the location of turbines is based largely on wind resource availability and areas outside of the CBA may not meet suitability criteria in this regard. However, from *Figure 5.2*, it is clear that moving or removing the turbines currently within the CBA would have a large effect on the scale or location of the development.

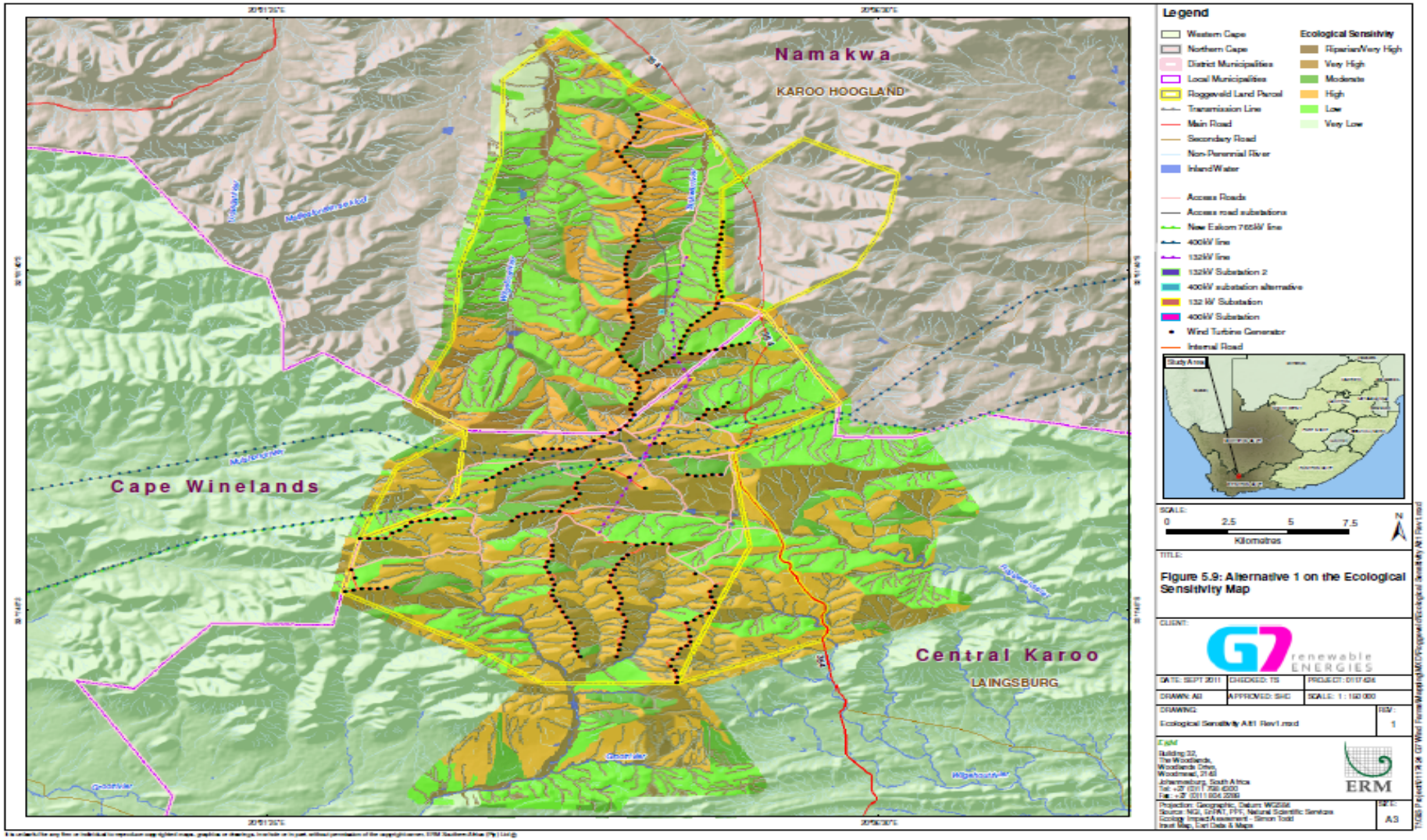
With regards to the second issue raised above, it is important to first recognize the context within which the CBA operates as well as ascertain why the particular area concerned has been classified as a CBA. Within vegetation types that are highly transformed, CBAs include a large proportion of

irreplaceable vegetation fragments that cannot be substituted. However, within the study area, all the vegetation types present are little transformed, with both Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld being 99% intact. Within semi-arid areas where the majority of vegetation is natural, there are often many choices as to which areas could fall under CBAs and the final solution may be a design issue rather than a clear-cut biodiversity-priority one. The extent to which this scenario is representative of the site is discussed below.

Within the study area, the extensive CBA within the Western Cape portion of the site is based on several different criteria, some of which show significant overlap with one another, indicating that some areas qualify for CBA status on several different grounds. A large proportion of this CBA is related to the fact that is has been identified as a priority area within the National Protected Area Expansion Strategy for South Africa (NPAES) (Government of South Africa 2008). This area was identified as priority area on that grounds that apart from being an extensive tract of unfragmented natural vegetation, it is also an area of high climate and landscape variation which is likely to be resilient to climate change. Such areas are likely to be more climatically stable over time, providing refugia where plants and animals can persist. As such, it is important to recognize that the site is therefore not replaceable due to the fact that the development encompasses a large proportion of the mountain range, and that there are not similar areas that can perform the same function and which contain a similar set of species available elsewhere. The Roggeveld is also a known centre of plant endemism (van Wyk & Smith 2001) and the western portion of the site falls within an area identified by experts as being an important area of plant diversity and endemism (SKEP Expert Map - Plants SKEP 2002).

The above discussion highlights the biological significance of the Roggeveld and draws attention to the potential impact of the development on the ecological functioning of the area. Impacts on endemic and listed plant species are a concern as are activities which result in the large-scale loss of CBA area or compromise the connectivity of the landscape. Although the development comprises a small proportion of the site, the impact of the development is not spread equitably across all vegetation and habitat types. As the turbines are restricted to ridgelines within a certain elevation range, these areas will be disproportionately affected and species which are confined to these areas will be similarly disproportionately impacted. A number of species and in particular several geophytes species were observed to be restricted to such ridgelines. This may be related to the fact that elevation is a primary determinant of temperature as well as rainfall.

Figure 5.2 Ecological sensitivity map



5.1.6 Birds

More than 210 bird species could possibly occur on the site including up to 14 red-listed species, 69 endemics or near-endemics, and three red-listed endemics (Ludwig's Bustard Neotis ludwigii, Blue Crane Anthropoides paradiseus and Black Harrier Circus maurus).

Sixty-three species were seen during the October site visit although none of these were red-listed species. The cliff lines, which are restricted either to the high ridges or to the steeply incised valleys of the larger watercourses, are small and broken, but hold at least one resident, breeding pair of Verreaux's Eagle Aquila verreauxii within the development area (nest site at 32º52.035 S, 20º30.216 E), and at least one other just off the R354 to the south-east, and may also support multiple breeding pairs of Rock Kestrel Falco tinnunculus, Jackal Buzzard Buteo rufofuscus, Booted Eagle Aquila pennatus and Cape Eagle Owl Bubo capensis, and possibly pairs of Peregrine Falcon Falco peregrinus and Lanner Falcon Falco biarmicus. Nests have been identified on the and immediately adjacent of Verreaux Eagle, Martial Eagle and Black Harrier (see *Figure 5.3*)

Three pairs of Martial Eagle *Polemaetus bellicosus* nest on pylons on the Droërivier-Muldersvlei (DRO-MVL tower 542; 32º54.950 S, 20º37.140) and Bachus-Droërivier (BA-DRO towers 530 and 50; 32º58.720 S, 20º24.945 and 32º59.430 S, 20º19.440 respectively) 400 kV transmission lines, although none of these sites has been occupied and active in recent years (Jenkins *et al.* 2007). Also notable is the location of a known Black Harrier nesting area along the upland watercourse in the Kabeltou/Brand Valley area. At least two pairs of this threatened endemic have been recorded as breeding in this area simultaneously in the last 5-10 years, presumably in particularly wet years. None were seen during the site visit which should have coincided with the late breeding season in this species (Curtis *et al.* 2004).

Additional important restricted range and/or endemic species which certainly or probably occur in the area include Karoo Korhaan *Eupodotis vigorsii*, Karoo Long-billed Lark *Certhilauda subcoronata*, Black-eared Sparrowlark *Eremopterix australis*, Layard's Titbabbler *Parisoma layardii*, Namaqua Warbler *Phragmacia substriata*, African Rock Pipit *Anthus crenatus* and Black-headed Canary *Serinus alario*.

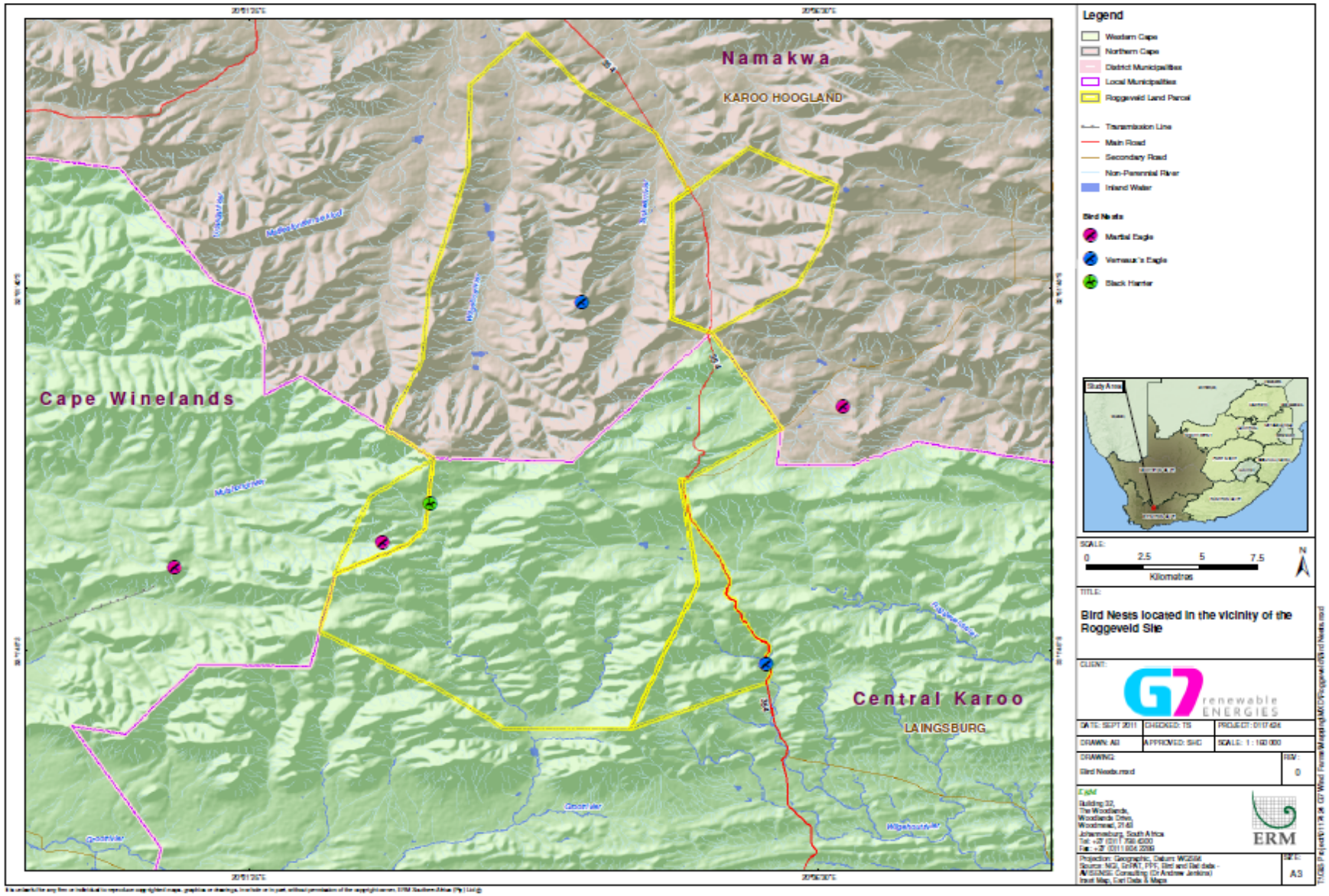
Nine priority species are recognized as key in the assessment of avian impacts of the proposed Roggeveld WEF. These are mostly nationally and/or globally threatened species which are known to occur, or could occur in relatively high numbers in the development area and which are likely to be, or could be, negatively affected by the WEF project. The site is not located within 50 km of any of the currently registered national Important Bird Areas (Barnes 1998).

Overall, the most important aspects of the avifauna on the Roggeveld WEF site, and those most relevant to this impact assessment, are:

(i) Resident and breeding raptors, in particular Verreaux's Eagle, Martial Eagle and Black Harrier (likely to occur regularly on site, and definitely breeds within it in wet years – Curtis *et al.* 2004), and possibly Cape Eagle-Owl *Bubo capensis*. All are scarce or threatened species, potentially susceptible to collision with and displacement from the area by the turbine arrays. Perhaps the main threat to raptors is the risk of exposure to turbine collisions when gliding along the most prominent ridge-lines. Such locations are likely to attract and concentrate the activities of all slope soaring species in the area, and turbines should be placed well back from the edge of steep slopes to minimise this potential negative impact.

(ii) Seasonal influxes of Ludwig's Bustard. This is a nomadic, nationally 'Vulnerable' and globally 'Endangered', near-endemic species, highly susceptible to collision mortality on power lines (Jenkins *et al.* 2010, Jenkins *et al.* 2010 in prep.), probably susceptible to turbine collision mortality, and possibly susceptible to disturbance and displacement by the wind farm. As a plains species it is not likely to frequent the high relief areas of the site, but could occur in the flatter, more open northern section and/or along the wider sections of the river valleys.

Figure 5.3 Identified nest sites

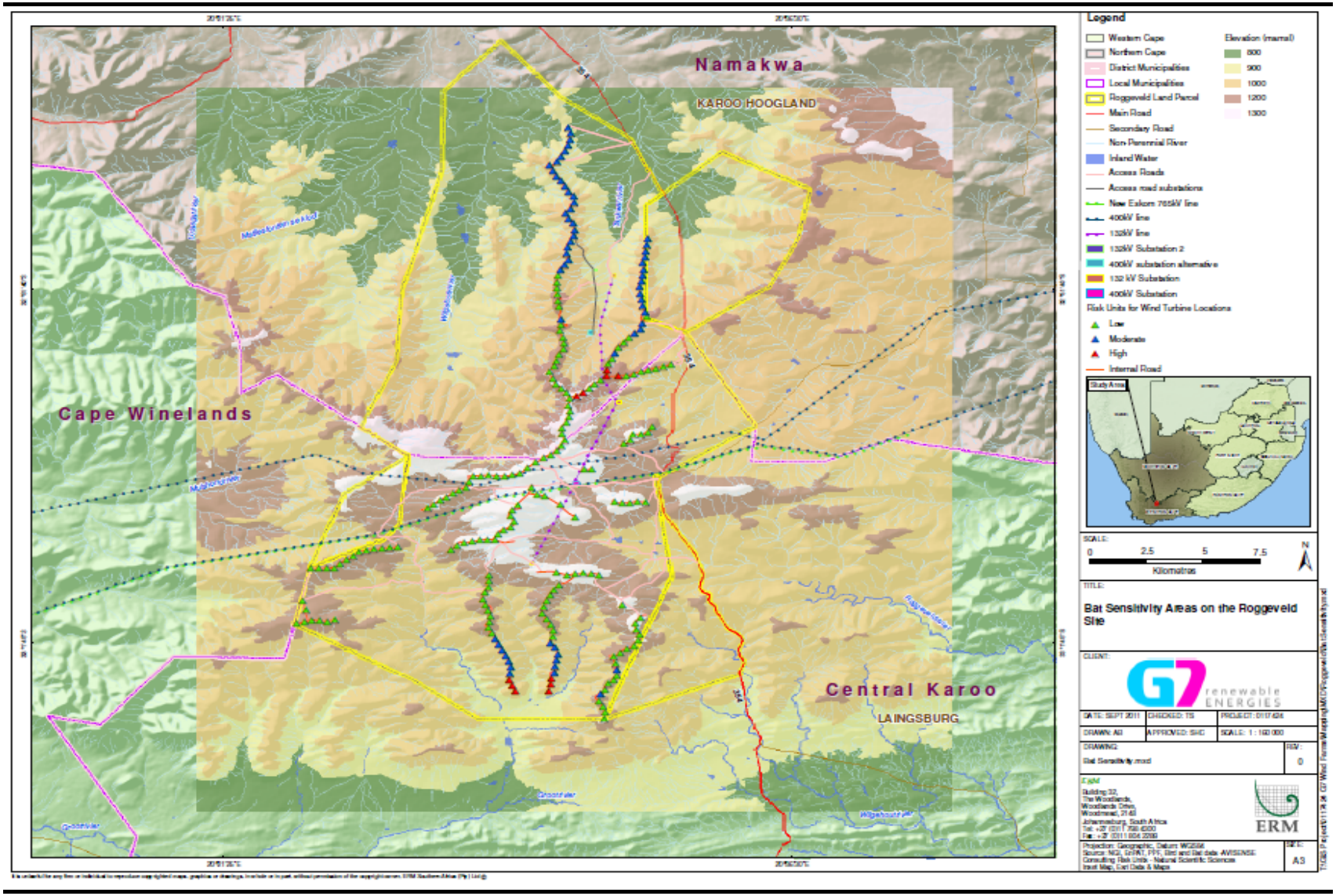


5.1.7 Bats

Two of the ten potential bat species likely to occur on site were acoustically recorded during three nights in total in September and December 2010.

There are three known migratory bat species in South Africa - (*Miniopterus natalensis* (Natal long-fingered bat), *Myotis tricolour* (Temminck's myotis) and *Rousettus aegyptiacus* (Egyptian rousette). These bats regularly undertake migratory flights between bushveld caves and highveld caves. High risk area for bat collision has been identified on the site as shown in *Figure 5.4.* There is a possibility that migratory species pass through the wider Roggeveld area during migration between roosts, although locations of roosting caves and migration routes in South Africa are poorly known and not well documented. Further, information on bat diversity, abundance, roost sites and migratory patterns at and near the study site is not available and requires monitoring to obtain a better understanding. Therefore, the impacts presented are difficult to evaluate with any degree of confidence at this stage, and has had to be inferred from observations of available habitat and limited sampling effort. A conservative approach should be adopted until longer term pre-construction monitoring is complete.

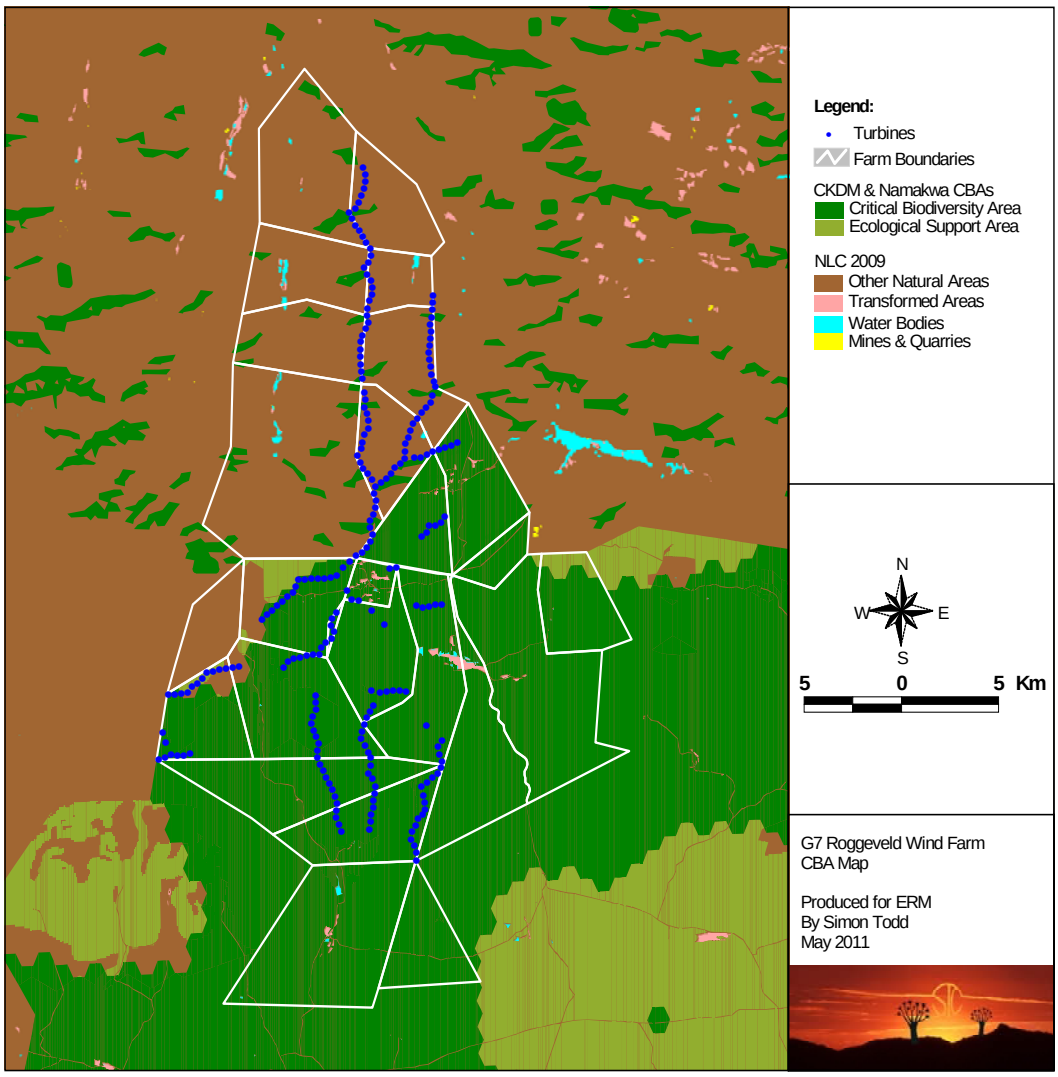
Figure 5.4 Bat sensitivity map



5.1.8 *Protected and Conservation Areas*

Cape Nature has indicated that much of the proposed site has been determined to be a Critical Biodiversity Area (CBA) [(1)] as shown in the *Figure 5.5.*

Figure 5.5 ***Critical Biodiversity Areas map of the proposed G7 Roggeveld Wind Farm and the surrounding area***



5.1.9 *Noise*

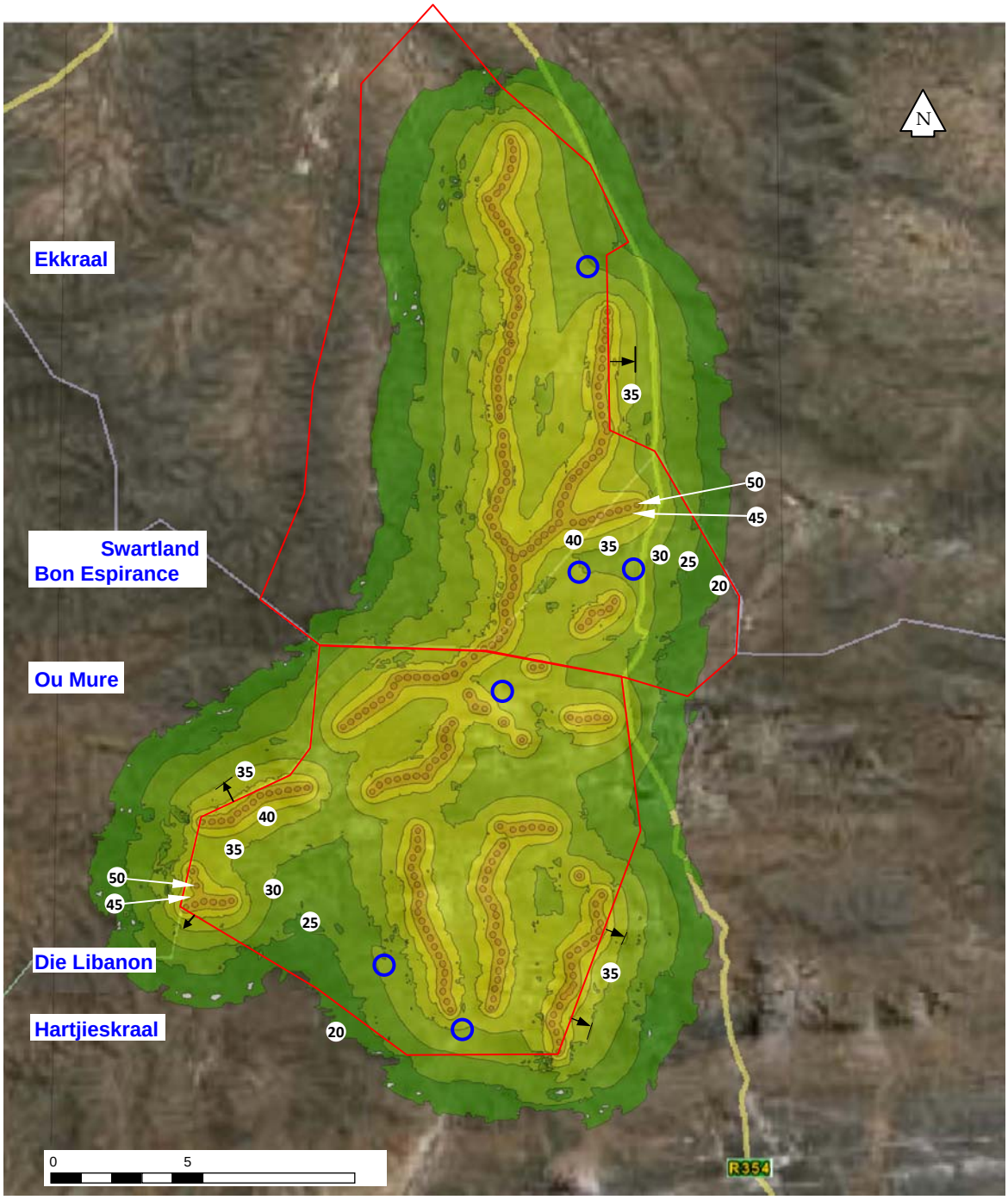
The proposed Roggeveld wind energy facility (WEF) site comprises several farms located along the R354 between Matjiesfontein in the south and Sutherland in the north. *Figure 5.6* displays the WEF site boundaries containing the farms in red.

(1) Bioregional plans are spatial plans published in terms of the Biodiversity Act. These map Critical Biodiversity Areas based on provincial or fine-scale biodiversity plans. These plans are used to inform land-use planning and environmental assessments, among others. According to SANBI CBAs should remain in a natural or near-natural state with no further loss or degradation of natural habitat.

The locations of the proposed 250 x 3MW wind turbines with 100 m high hub height are at the centre of the orange circles.

The land is rural with several farm dwellings located within the site boundaries. Six of these residences, demarcated by blue circles, were identified as being located within the predicted wind turbine noise contour footprint. The names of the farm residences are displayed to the left of *Figure 5.6* in line with the respective blue circles. All, excepting Swartland, are located far from sources of man-made noise.

Figure 5.5 *Roggeveld proposed wind farm with site boundaries demarcated by red lines;; farm dwellings demarcated by blue circles; and calculated LAeq contours due to noise from wind turbines.*



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