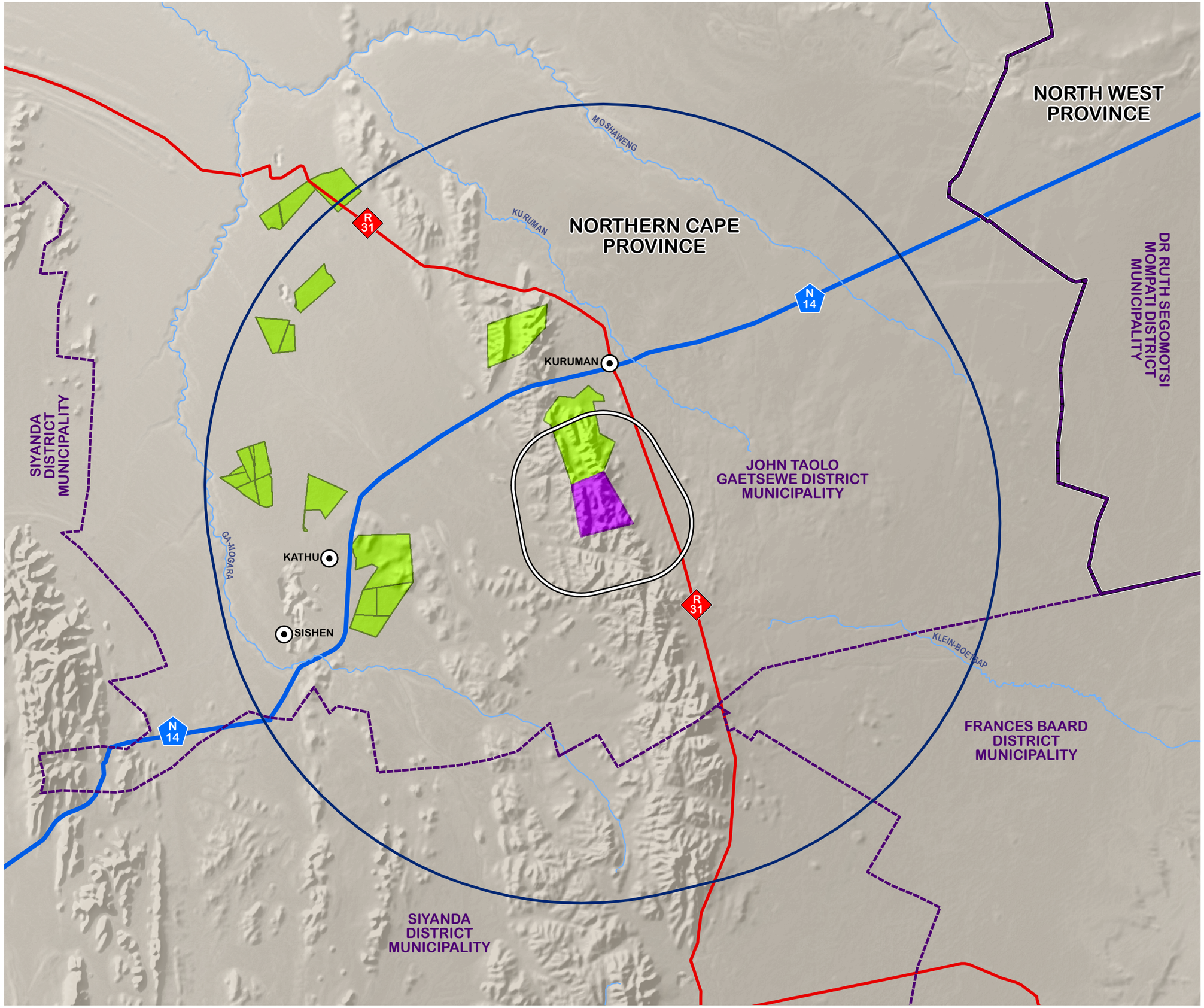
PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 2)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: OTHER PROPOSED RENEWABLE ENERGY DEVELOPMENTS WITHIN 50KM RADIUS



Legend

- Main Towns
- Provincial Boundaries
- District Municipal Boundaries
- National Routes
- Main Arterial Routes
- Main Rivers
- Kuruman WEF Phase 2 Application Site
- 8km Visual Assessment Zone
- 50km Radius
- Renewable Energy Application Sites

SOURCE:
MUNICIPAL DEMARCATION BOARD, 2011
NGI, 2014

N

0 6 12

Kilometers

SiVEST

ENVIRONMENTAL DIVISION
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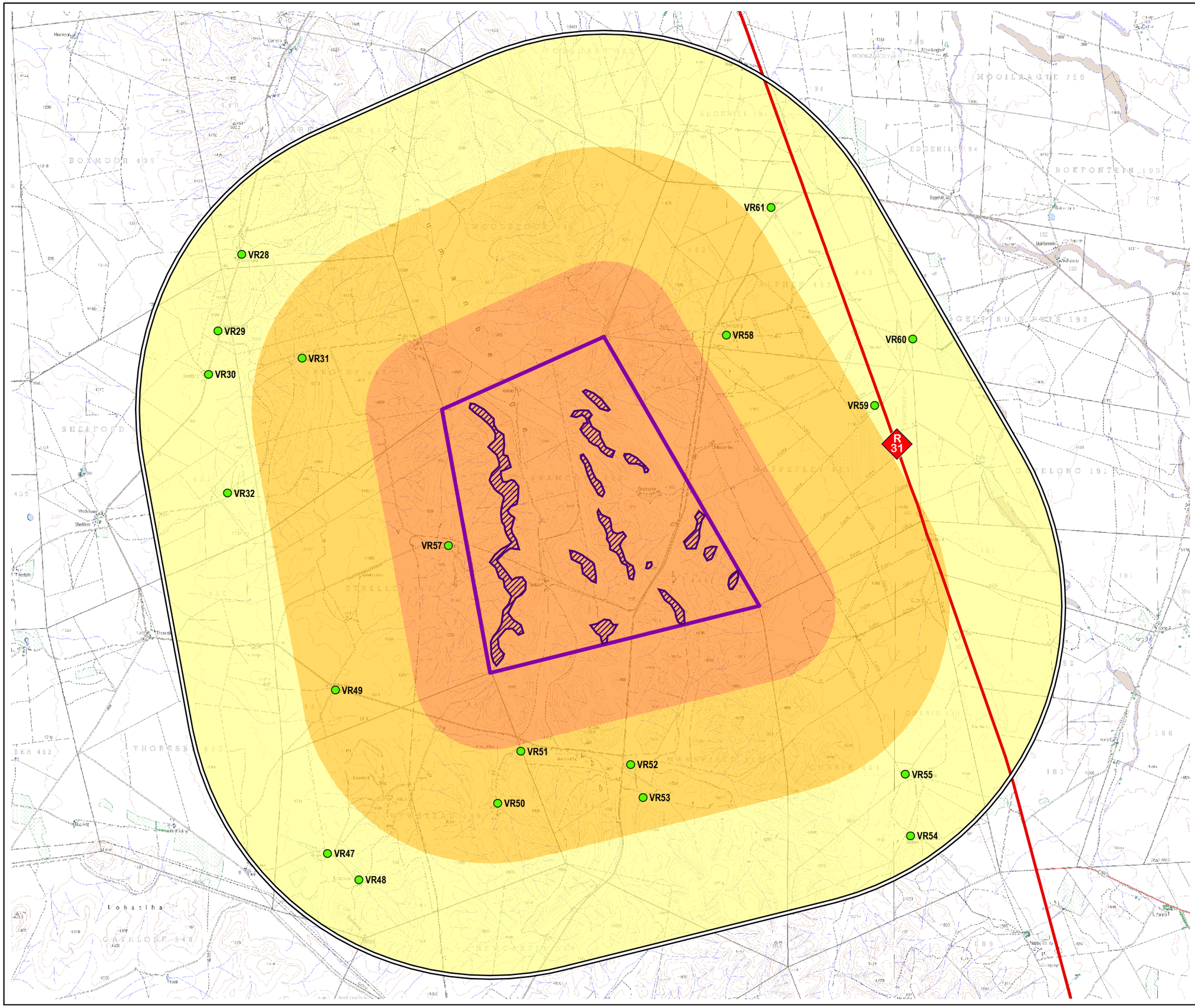
Project No	Prepared By	Date
14869	KLS	09/03/2018
Map Ref No	**Revision**	**Date**
14869/SC2_07	0	_____

THIS MAP HAS BEEN PREPARED UNDER THE CONTROLS ESTABLISHED BY THE SiVEST QUALITY MANAGEMENT SYSTEM WHICH HAS BEEN CERTIFIED ISO 9001:2008 COMPLIANT



PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 2)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: POTENTIALLY SENSITIVE VISUAL RECEPTOR LOCATIONS

Legend

- Main Arterial Routes
- Rivers/Watercourses
- Kuruman WEF Phase 2 Application Site
- Turbine Asessment Corridors
- 8km Visual Assessment Zone
- Potentially Sensitive Receptor Locations

Zones of Potential Visual Impact

- High Impact (<=2kms)
- Moderate Impact (2.1 - 5kms)
- Low Impact (5.1 - 8kms)

SOURCE:
MUNICIPAL DEMARCATION BOARD, 2011
NGI, 2014

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0 1 2

Kilometers

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Project No	Prepared By	Date
14869	KLS	09/03/2018
Map Ref No	**Revision**	**Date**
14869/SC2_08	0	_____

PROPOSED CONSTRUCTION OF THE KURUMAN WIND ENERGY FACILITY (PHASE 2)

NEAR KURUMAN, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT: VISUAL SENSITIVITY

Legend

- Main Towns
- Secondary Road
- Kuruman WEF Phase 2 Application Site
- Turbine Asessment

Visual Sensitivity

- High
- Medium
- Medium Low
- Low

Proposed Infrastructure

- Proposed Collector Substation
- Proposed Laydown
- Proposed Access
- Proposed 33kV Overhead Lines

SOURCE:
MULILO RENEWABLE POWER PROJECTS, 2017
NGI, 2014

N

0 0.5 1

Kilometers

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Project No	Prepared By	Date
14869	KLS	09/03/2018
Map Ref No	**Revision**	**Date**
14869/SC2_10	0	

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Kuruman WEF:

for the Proposed Development of the Phase 2 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province: SCOPING REPORT

Report prepared for:

CSIR – Environmental Management Services

P O Box 320

Stellenbosch

7600

Report prepared by:

CTS Heritage

34 Harries Street

Plumstead, Cape Town

7800

17 April 2018

SPECIALIST EXPERTISE

SPECIALIST DECLARATION

I, **Nicholas George Wiltshire**, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

I act as the independent specialist in this application;
I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I have no vested interest in the proposed activity proceeding;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
all the particulars furnished by me in this specialist input/study are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of Specialist: Nicholas George Wiltshire

Date: 01 February 2018

LIST OF ABBREVIATIONS

AIA	Archaeological Impact Assessment
DARD	Department of Agriculture and Rural Development (KwaZulu-Natal)
DEA	Department of Environmental Affairs (National)
DEADP	Department of Environmental Affairs and Development Planning (Western Cape)
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism (Eastern Cape)
DEDECT	Department of Economic Development, Environment, Conservation and Tourism (North West)
DEDT	Department of Economic Development and Tourism (Mpumalanga)
DEDTEA	Department of economic Development, Tourism and Environmental Affairs (Free State)
DENC	Department of Environment and Nature Conservation (Northern Cape)
DMR	Department of Mineral Resources (National)
GDARD	Gauteng Department of Agriculture and Rural Development (Gauteng)
HIA	Heritage Impact Assessment
LEDET	Department of Economic Development, Environment and Tourism (Limpopo)
MPRDA	Mineral and Petroleum Resources Development Act, no 28 of 2002
NEMA	National Environmental Management Act, no 107 of 1998
NHRA	National Heritage Resources Act, no 25 of 1999
PIA	Palaeontological Impact Assessment
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
VIA	Visual Impact Assessment

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TABLES AND FIGURES

KURUMAN WEF

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, "Mulilo") appointed the Council of Scientific and Industrial Research (hereafter, "CSIR"). Mulilo has proposed to build the Kuruman Wind Energy Facility (WEF) in two phases (1&2).

Number of turbines to be completed in Phase 2: 52. Each turbine has a maximum output of 4.5MW, blade height of 140m and blade length of 80m.

Additional infrastructure assessed for the EIA will include 5m wide connecting roads and widening of existing roads to 5m. New roads constructed will connect all turbines.

The WEF will also be connected to the grid via two 132kV overhead powerlines to Kuruman (Segame Substation, 10km in length) and Kathu (Ferrum Substation, 50km in length). In addition, 33kV overhead lines at a height of 5m will run along jeep tracks as service roads below the overhead lines.

A collector substation (Eskom Metering Station) reaching a height of 30m over a 2ha footprint will be constructed in the Phase 1 inclusion zone. A new switching station would have to be constructed next to the existing Eskom substation, for the project to connect into it.

Three construction yards will be established. It is anticipated that each construction yard will consist of the following:

-Welfare facilities:
- Canteen
- Toilets
- Changing rooms
- Offices
- Meeting rooms
- Parking

- Storage including;
  - Bunded fuel areas
  - Oil storage areas

- General stores (containers)
- Skips

Average weekly water requirements will comprise 409,640 litres. High water use is only anticipated for the first 6 months of the 18-month construction phase of turbine bases, roads and dust suppression. Operational phase average weekly water requirement: 100 litres. Source is expected to be from borehole water. A groundwater census should be included in this application.

Depth of excavation (m): 3m

Height of development (m): 140m turbines, 30m collector substation, underground powerlines (5-10m)

Expected years of operation before decommission: 20 years

1.1.2. Terms of Reference

The Terms of Reference for this report are as follows:

- Heritage sensitivity map based on desktop work and a site meeting;
- A scoping input report, detailing the high-level impacts that may occur due to the development of the WEFs. The report must include a description of the potential cumulative impacts (a scoping assessment report template can be provided by the CSIR)

1.1.3. Approach and Methodology

A Basic Assessment (BA) process will also be undertaken for an Eskom metering station, substation and 132kV transmission lines to the Ferrum Substation (distance 50km) and the Segame Substation (distance 10km).

A Heritage Screening Assessment was conducted for the proposed development (Appendix A). The Heritage Screener summarises the heritage impact assessments and studies previously undertaken within the area of the proposed development and its surroundings. Heritage resources identified in these reports are assessed by our team during the screening process.

The heritage resources will be described both in terms of **type**:

- Group 1: Archaeological, Underwater, Palaeontological and Geological sites, Meteorites, and Battlefields
- Group 2: Structures, Monuments and Memorials
- Group 3: Burial Grounds and Graves, Living Heritage, Sacred and Natural sites
- Group 4: Cultural Landscapes, Conservation Areas and Scenic routes

and **significance** (Grade I, II, IIIa, b or c, ungraded), as determined by the author of the original heritage impact assessment report or by formal grading and/or protection by the heritage authorities.

Sites identified and mapped during research projects will also be considered.

DETERMINATION OF THE EXTENT OF THE INCLUSION ZONE TO BE TAKEN INTO CONSIDERATION

The extent of the inclusion zone to be considered for the Heritage Screener will be determined by CTS based on:

- the size of the development,
- the number and outcome of previous surveys existing in the area
- the potential cumulative impact of the application.

The inclusion zone will be considered as the region within a maximum distance of 50km from the boundary of the proposed development.

DETERMINATION OF THE PALAEONTOLOGICAL SENSITIVITY

The possible impact of the proposed development on palaeontological resources is gauged by:

- reviewing the fossil sensitivity maps available on the South African Heritage Resources Information System (SAHRIS)
- considering the nature of the proposed development
- when available, taking information provided by the applicant related to the geological background of the area into account

DETERMINATION OF THE COVERAGE RATING ASCRIBED TO A REPORT POLYGON

Each report assessed for the compilation of the Heritage Screener is colour-coded according to the level of coverage accomplished. The extent of the surveyed coverage is labeled in three categories, namely low, medium and high. In most instances the extent of the map corresponds to the extent of

the development for which the specific report was undertaken.

Low coverage will be used for:

- desktop studies where no field assessment of the area was undertaken;
- reports where the sites are listed and described but no GPS coordinates were provided.
- older reports with GPS coordinates with low accuracy ratings;
- reports where the entire property was mapped, but only a small/limited area was surveyed.
- uploads on the National Inventory which are not properly mapped.

Medium coverage will be used for

- reports for which a field survey was undertaken but the area was not extensively covered. This may apply to instances where some impediments did not allow for full coverage such as thick vegetation, etc.
- reports for which the entire property was mapped, but only a specific area was surveyed thoroughly. This is differentiated from low ratings listed above when these surveys cover up to around 50% of the property.

High coverage will be used for

- reports where the area highlighted in the map was extensively surveyed as shown by the GPS track coordinates. This category will also apply to permit reports.

RECOMMENDATION GUIDE

The Heritage Screener includes a set of recommendations to the applicant based on whether an impact on heritage resources is anticipated. One of three possible recommendations is formulated:

(1) The heritage resources in the area proposed for development are sufficiently recorded - The surveys undertaken in the area adequately captured the heritage resources. There are no known sites which require mitigation or management plans. No further heritage work is recommended for the proposed development.

This recommendation is made when:

- enough work has been undertaken in the area
- it is the professional opinion of CTS that the area has already been assessed adequately from a heritage perspective for the type of development proposed

(2) The heritage resources and the area proposed for development are only partially recorded - The surveys undertaken in the area have not adequately captured the heritage resources and/or there are sites which require mitigation or management plans. Further specific heritage work is recommended for the proposed development.

This recommendation is made in instances in which there are already some studies undertaken in the area and/or in the adjacent area for the proposed development. Further studies in a limited HIA may include:

- improvement on some components of the heritage assessments already undertaken, for instance with a renewed field survey and/or with a specific specialist for the type of heritage resources expected in the area
- compilation of a report for a component of a heritage impact assessment not already undertaken in the area
- undertaking mitigation measures requested in previous assessments/records of decision.

(3) The heritage resources within the area proposed for the development have not been adequately surveyed yet - Few or no surveys have been undertaken in the area proposed for

development. A full Heritage Impact Assessment with a detailed field component is recommended for the proposed development.

1.1.4. Assumptions and Limitations

This report is a scoping report only. As such no field study has taken place (besides the site meeting).

The following aspects have a direct bearing on the investigation and the resulting report:

- The *significance* of the sites and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

- It should be noted that archaeological deposits often occur below ground level. Should artefacts or skeletal material be revealed at the site during construction, such activities should be halted, and it would be required that the heritage consultants are notified for an investigation and evaluation of the find(s) to take place.

- The Kuruman Hills have historically been used for small scale pastoralist farming activities with goats and sheep, a practice which extends back possibly as much as 2 000 years ago when Khoekhoe herders first entered the area.

1.1.4a Limiting/Restricting factors

The investigation has been influenced by the following factors related to the overall EIA:

- Availability and reliability of baseline information about the affected area;
- Unpredictability of buried archaeological/palaeontological remains (absence of evidence does not mean evidence of absence);

1.1.5. Source of Information

Field work
No field work has taken place for the Scoping Phase of the project. The study draws on desktop research from several approved heritage impact assessments and specialist studies from the area. Fieldwork will be conducted as part of the final HIA for the proposed development.

Desktop study
Information was obtained from various impact assessment reports and specialist studies. The body of literature is listed below:

Reference List

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
123045	AIA	Cobus Dreyer	26/06/2013	Report Eskom Garona Ferrum Mercury
152170	HIA	Robert de Jong	03/09/2008	Heritage Impact Assessment Report: Proposed Residential Development And Associated Infrastructure On A 200 Ha Portion Of The Farm Bestwood 429 Rd At Kathu, Northern Cape Province
152171	AIA	Cobus Dreyer	11/08/2008	First Phase Archaeological And Cultural Heritage Assessment Of The Proposed Residential Developments At A Portion Of The Remainder Of The Farm Bestwood 459rd, Kathu, Northern Cape

156617	AIA	David Morris	01/02/2014	Rectification and/or regularisation of activities relating to the Bestwood Township development near Kathu, Northern Cape: Phase 1 Archaeological Impact Assessment
163959	HIA	Anton van Vollenhoven	17/03/2014	HIA Eskom Manganore to Ferrum Scoping Phase
170455	AIA	Neels Kruger	31/03/2014	Archaeological Impact Assessment Of Demarcated Surface Portions On The Farms Sacha 468, Sims 462 And Sekgame 461 For The Proposed Stormwater Infrastructure (clean Water Cut-off Berm & Groundwater Dam) For The Sishen Mine, Kathu, Northern Cape Province.
170660	AIA	Cobus Dreyer	31/01/2014	First Phase Archaeological & Heritage Assessment Of the Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
170664	AIA	Cobus Dreyer	28/09/2012	First Phase Archaeological And Heritage Assessment Of the Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
170666	AIA	Cobus Dreyer	31/12/2013	First Phase Archaeological And Heritage Assessment Of The Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
279906	AIA	Neels Kruger	02/12/2014	Archaeological Impact Assessment Of Demarcated Surface Portions On The Farm Sekgame 461 For The Proposed Sekgame Electricity Infrastructure Expansion Project, Sishen Mine, Northern Cape Province
294454	AIA	Neels Kruger	05/04/2015	Archaeological Impact Assessment Of Areas Demaracted For The Proposed Lyleveld North Waste Rock Dump Expansion And Lyleveld South Haul Road Extension Project, Sishen Mine, Northern Cape Province
324952	HIA	Lloyd Rossouw	07/07/2015	Phase 1 Heritage Impact Assessment of the 2.3 km long 40478 Vaal-Gamagara water pipeline alternative route around Kathu Pan, Northern Cape Province
329708	HIA	Anton van Vollenhoven	01/11/2014	HIA Eskom Manganore-Ferrum for EIA Phase
6339	AIA	David Halkett	24/08/2009	An archaeological scoping assessment of the remainder and portion 1 (Tierkop) of farm Bramcote 446, Northern Cape Priovince.

Palaeontological Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
114648	PIA	John E Almond	01/09/2012	Palaeontological Specialist Assessment: Desktop Study Proposed 16 Mtpa Expansion Of Transnet's Existing Manganese Ore Export Railway Line & Associated Infrastructure Between Hotazel And The Port Of Ngqura, Northern & Eastern Cape.

Web References
http://pza.sanbi.org/vegetation/nama-karoo-biom http://pza.sanbi.org/vachellia-erioloba http://pza.sanbi.org/sites/default/files/info_library/camelthorns_khathu_pdf.pdf http://www.museumsnc.co.za/aboutus/depts/education/GuidePlants.pdf https://www.sciencedirect.com/science/article/pii/S0195925509000857

1.2. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Section 38 of the National Heritage Resources Act (25 of 1999) applies.

This study constitutes a heritage scoping investigation linked to the environmental impact scoping and impact assessment required for the development. The proposed development is a listed activity in terms of Section 38 (1) of the NHRA.

Section 38 (2)(a) of the National Heritage Resources Act (Act 25 of 1999) requires the submission of a heritage impact assessment report for authorization purposes to the responsible heritage resources agency, SAHRA. Heritage conservation and management in South Africa (excluding KwaZulu-Natal on a provincial level) is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA) and falls under the jurisdiction of the South African Heritage Resources Agency (SAHRA) and its provincial offices and counterparts.

Section 38 of the NHRA requires a Heritage Impact Assessment (HIA) be conducted by an independent heritage management consultant for the following development categories:

38. (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—

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

Should the proposed development fall within any of the categories described in Section 38(1), the appropriate heritage authority may require a Heritage Impact Assessment in terms of Section 38(3) of the NHRA. According to Section 38(3);

The responsible heritage resources authority must specify the information to be provided in a heritage report required provided that the following must be included:

(a) The identification and mapping of all heritage resources in the area affected;
(b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;
(c) an assessment of the impact of the development on such heritage resources;
(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) plans for mitigation of any adverse effects during and after the completion of the proposed development.

As the proposed development is subject to an EIA in terms of NEMA, Section 38(8) of the NHRA applies. Section 38(8) states that:

“The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources

authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent."

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1. Baseline description of the receiving environment

The inclusion zone is situated within the Savanna Biome. The Savanna Biome comprises 46 percent of southern Africa's land mass, therefore is the largest Biome in southern Africa. This Biome is characterized by C4-type grasses in plains areas, which is indicative of a summer rainfall zone. In addition, distinct upper layer of woodland and bushveld are observable on mountainous and intermediate areas respectively. The Kruger and Kalahari Gemsbok National Parks contain this vegetation type; therefore, Savanna Biome vegetation is effectively conserved. However, only 5 percent of the total vegetation Biome is formally conserved.

Approximately 35km to the southwest of the inclusion zone is Kathu, where a large Camel Thorn Tree (*Vachellia erioloba*) forest is conserved. Known as the Kathu Forest, it is approximately 4000ha and has been declared a National Heritage Site. Camel Thorns provide ecological support for the Sociable Weaver and their large nests and are depended upon by several other bird and animal species, many of which are listed endemic and protected species. As the inclusion zone is proximal to the Kathu forest, it likely also hosts areas of vegetation that is ecologically sensitive.

1.3.2. Results of the Desktop Study

The Kuruman Hills have historically been used for small scale pastoralist farming activities with goats and sheep, a practice which extends back possibly as much as 2000 years ago when Khoekhoe herders first entered the area. Three sites with possible herder art (TK1, TK3 & TK5) were found in association with Later Stone Age artefact assemblages on the Tierkop farm. These sites were recorded during a survey by Dave Halkett and Jayson Orton (Halkett 2009) for the potential impacts of iron and manganese ore mining on Bramcote farm (No 446).

Phase 1 of the WEF is located on a number of farms in the vicinity of Kuruman in the Northern Cape (see Table below). This area has not been surveyed previously and we expect similar findings will be made such as ruined farm infrastructure, possible old mines, ESA, MSA and LSA open site scatters of artefacts, possibly more rock art sites in overhangs and a number of visual impacts will have to be assessed in terms of the cultural landscape encompassed by the inner valley and boundary hills containing the proposed WEF. Wonderwerk Cave, a National Heritage Site containing archaeological traces stretching back over 2 million years, is located ~25km to the southeast of the WEF.

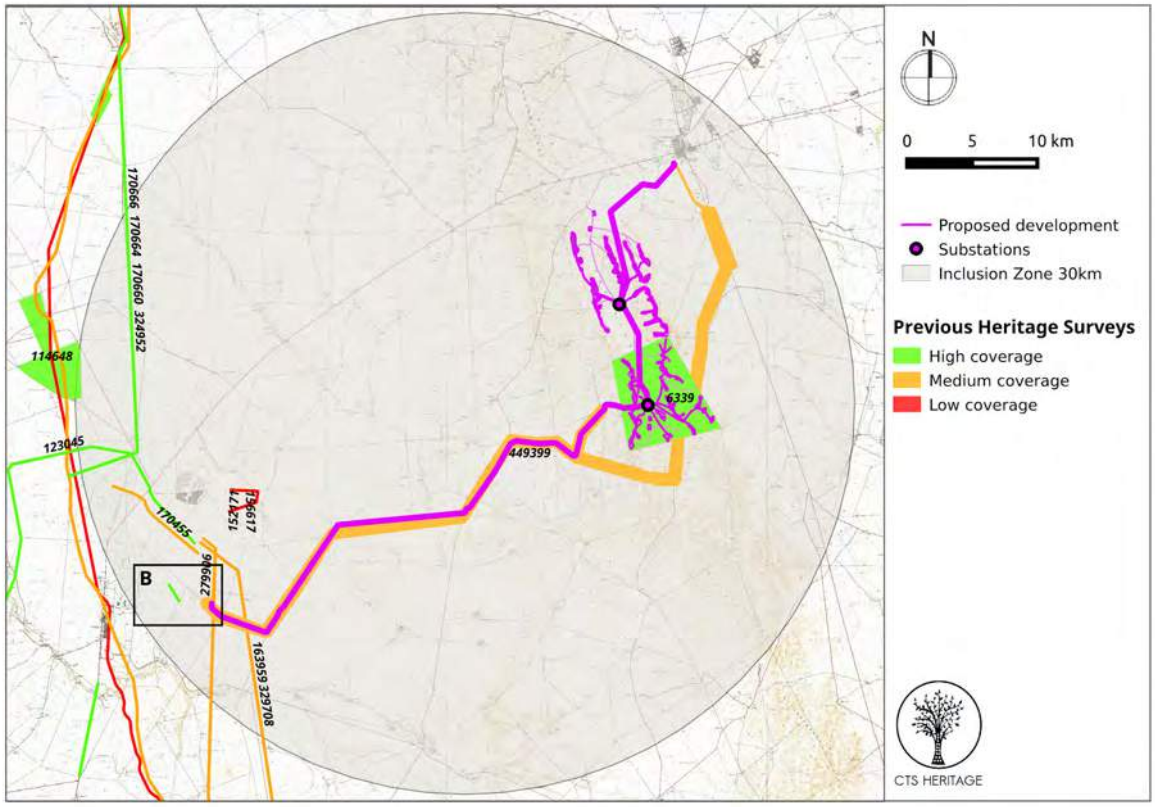
In terms of geology, the WEF and powerline footprint is underlain by Precambrian sediments and lavas of the Transvaal Supergroup, including the Ghaap Group (marine carbonates of the Campbell Rand Subgroup followed by banded iron formations of the Asbestos Hills Subgroup) and Postmasburg Group (Ongeluk Formation lavas). Most of these rock units are of low palaeontological sensitivity. However, the Campbell Rand carbonates near Kuruman may be stromalite-rich (high sensitivity). Late Caenozoic superficial sediments include windblown sands (Kalahari Group), colluvial and other surface gravels, alluvium and pedocretes (e.g. calcretes). Most of these younger sediments are of low sensitivity but older alluvial deposits along major drainage lines as well as calcretes need to be inspected for fossils (e.g. mammalian remains).

The heritage resources along the routes proposed for development are only partially recorded. Based on the available information, the proposed development is likely to impact on heritage resources and as such, it is recommended that a complete Heritage Impact Assessment (which includes archaeological and palaeontological impact assessments) is required that assesses impacts to landscape character, secondary (and possibly primary) impacts on built environment resources, archaeological resources, graves and burial grounds, fossil heritage and mining heritage.

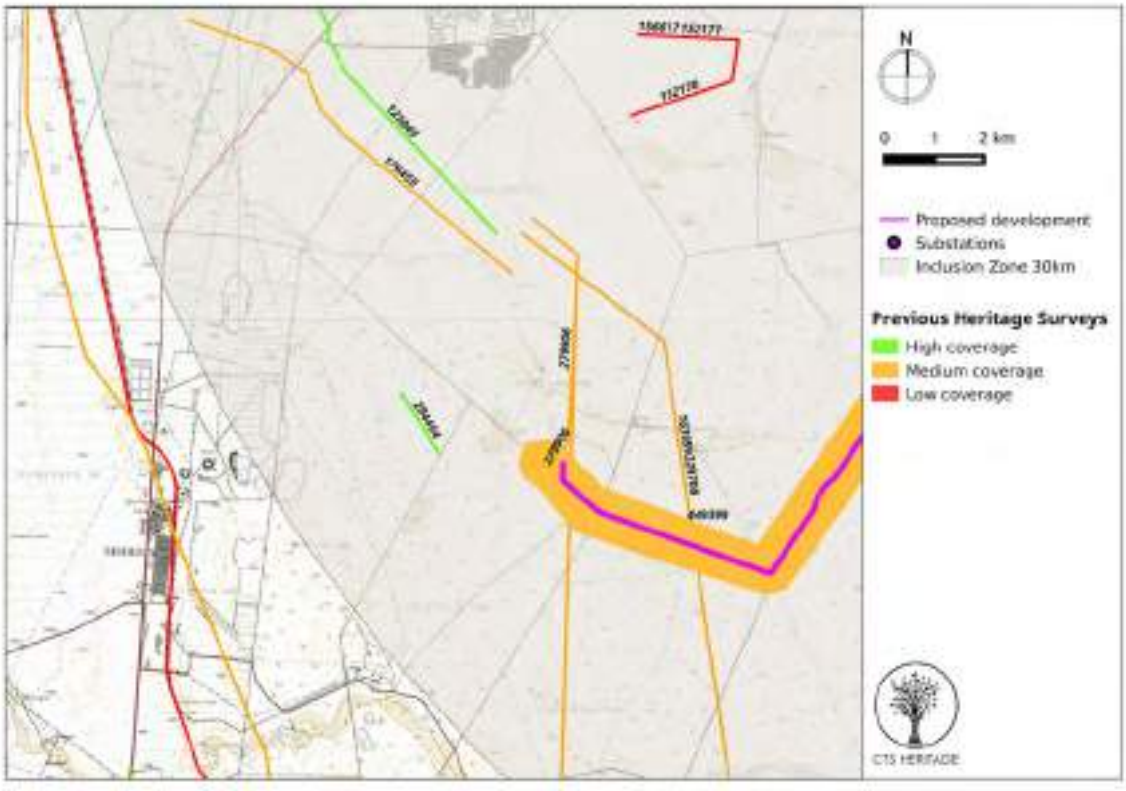
Affected Farm Portions

Farm Name	Portion Nr/Farm
Woodstock	RE/441
Bramcote	1/446
Strelley	RE/448
Strelley	1/448
Thoresby	2/450
Thoresby	RE/450
Thoresby	1/450
Clumber	RE/453
Clumber	3/453
Clumber	4/453
Clumber	6/453
Welbeck	RE/454
Welbeck	2/454
Hartland	2/381
Hartland	1/381
Rossdale	RE/382
Legoko	RE/460
Legoko	1/460
Sekgame	RE/461
Kuruman	ERF 1

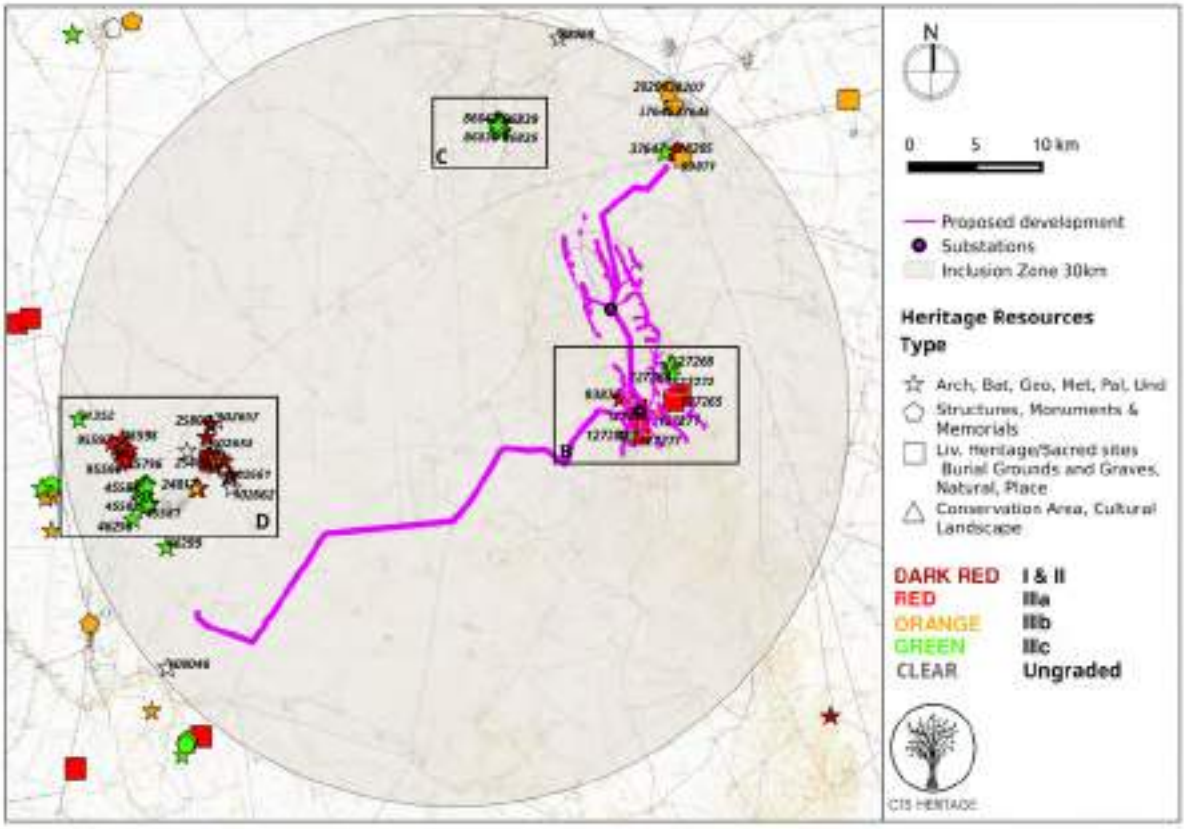
1.3.3. Heritage Sensitivity Maps



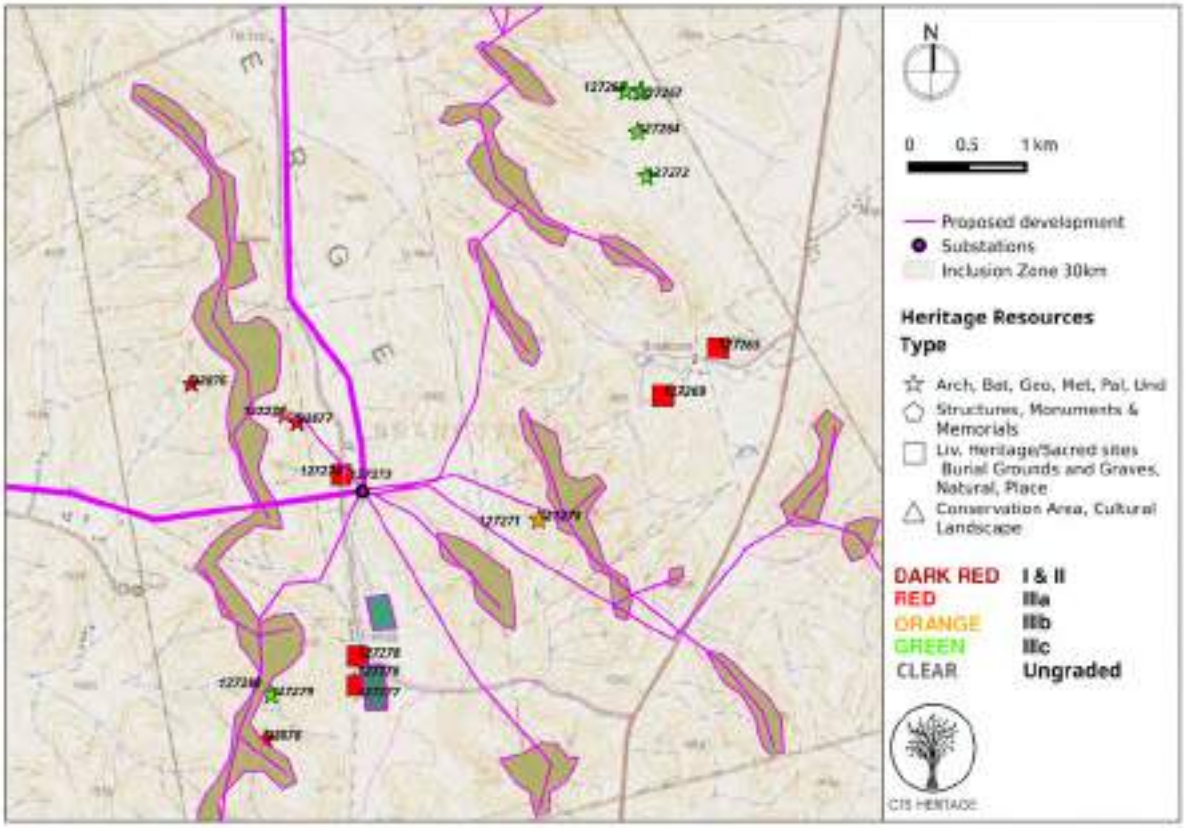
13.3.3a Previous HIAs Map. Previous Heritage Impact Assessments surrounding the proposed development area within 30kms, with SAHRIS NIDS indicated



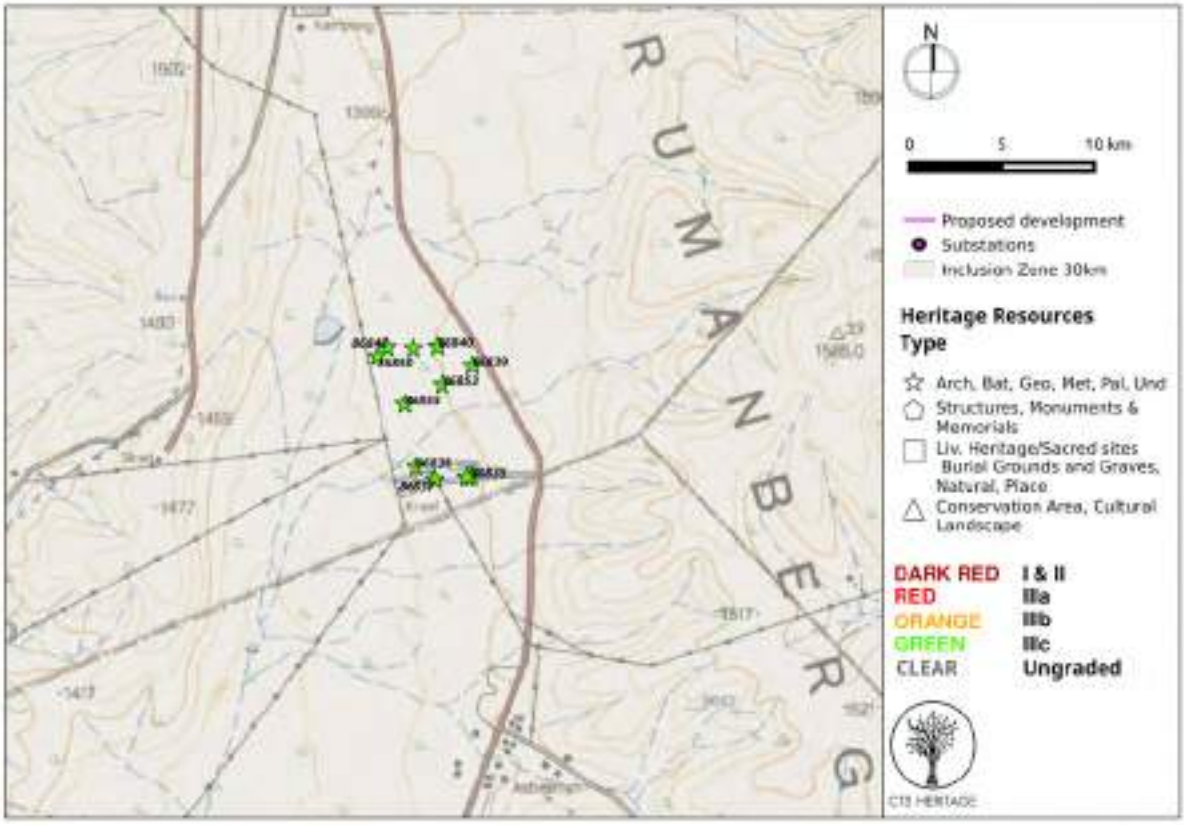
13.3.3b. Inset Map B



13.3.3c Heritage Resources Map. Heritage resources previously identified in and near the study area, with SAHRIS Site IDs indicated



13.3.3d Inset Map B



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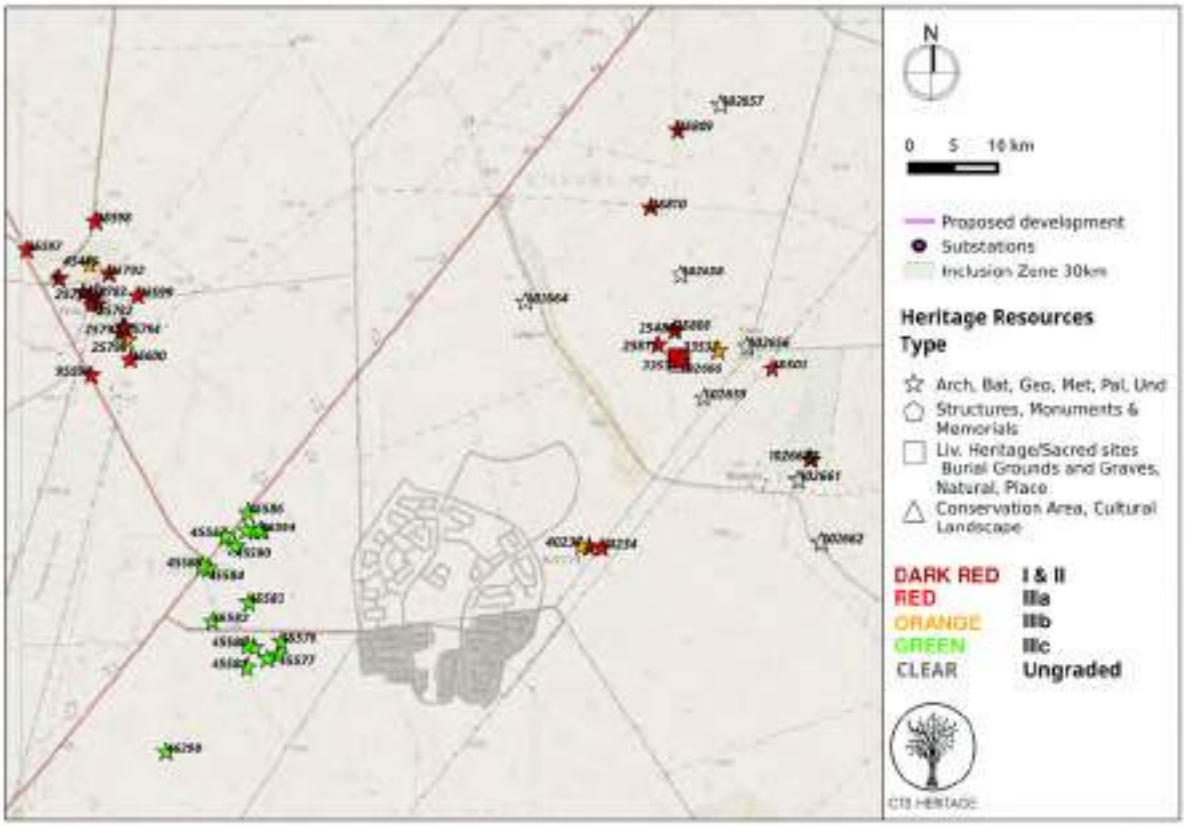
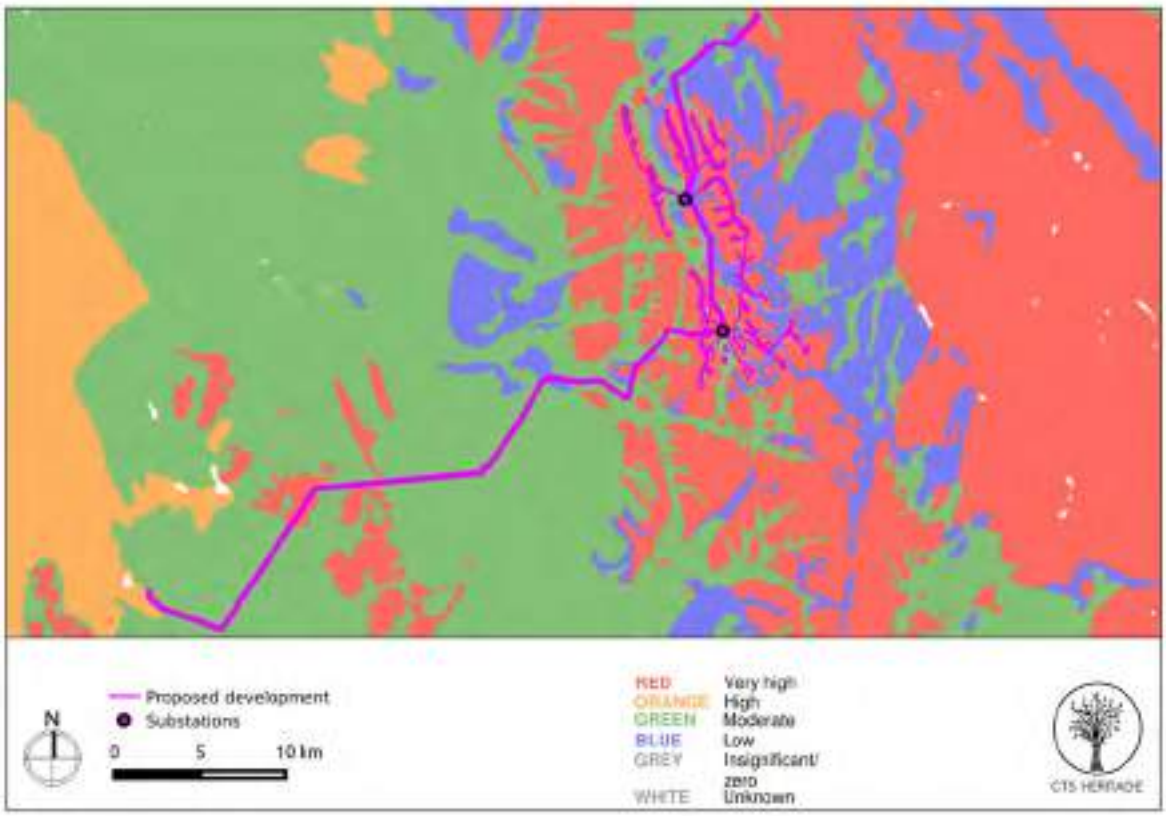
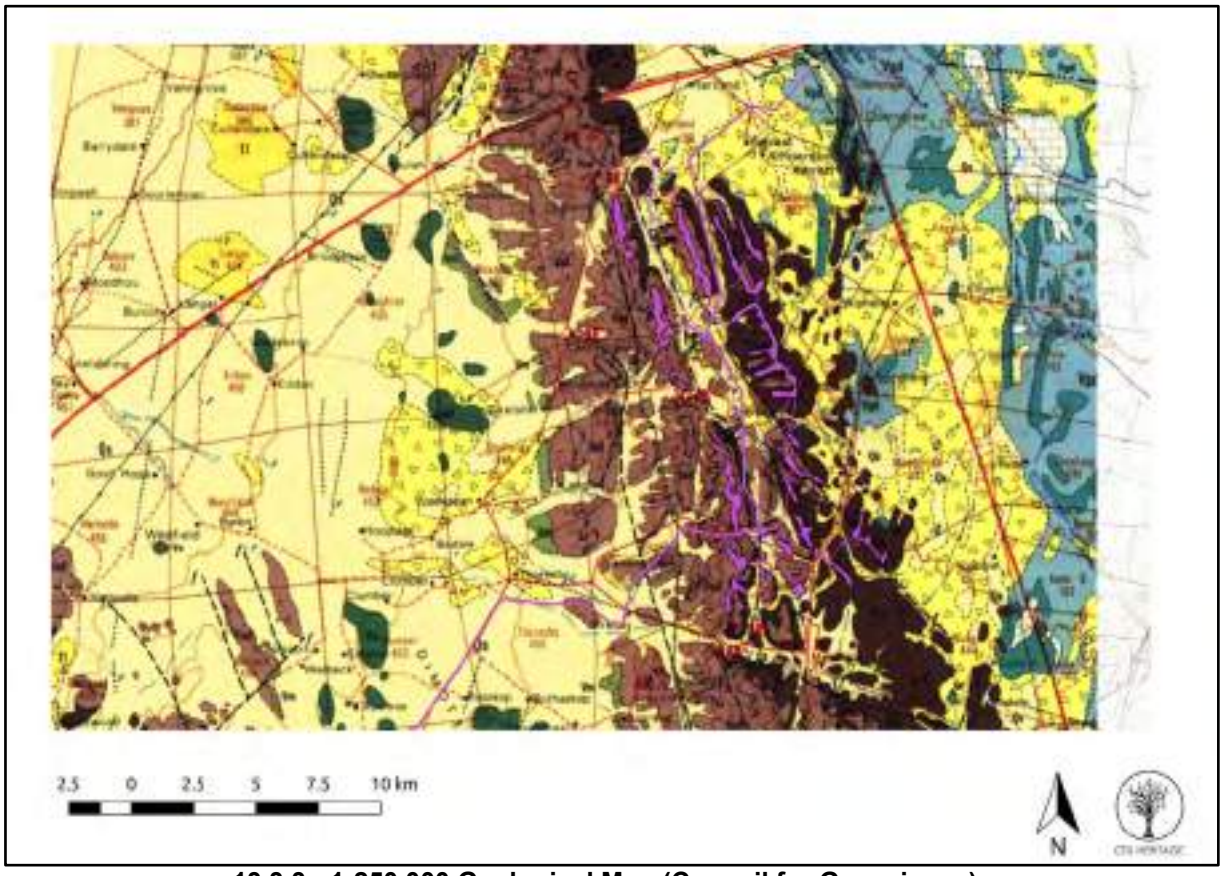


13.3.3e Inset Map D



13.3.3f Palaeosensitivity Map, indicating varied fossil sensitivity underlying the study area.



13.3.3g 1:250 000 Geological Map (Council for Geoscience).

1.4. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE KURUMAN WEF

Project Aspect: Construction of roads and infrastructure related to the WEF.

Project Impact: Destruction of heritage resources including archaeology, palaeontology and cultural landscape resources.

1.5. IDENTIFICATION OF IMPACTS

1.5.1. Identification of Potential Impacts

Based on the previously mentioned historical significance regarding the Kuruman Hills history of small scale pastoralist farming activities with goats and sheep, along with three sites where possible herder art were found in association with Later Stone Age artefact assemblages on the Tierkop farm, the potential footprint of the proposed development will impact heritage resources.

We expect similar findings will be made such as:

- ESA, MSA and LSA open site scatters of artefacts.
- Rock art sites in overhangs and many visual impacts will have to be assessed in terms of the cultural landscape encompassed by the inner valley and boundary hills containing the proposed WEF.
- Palaeontological fossils.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.6.1. Construction Phase

Nature of impact:

- Destruction of archaeological artefacts.
- Destruction of pastoralist cultural landscape of heritage and historical significance.
- Destruction of palaeontological material (mainly of Precambrian Stromatolites).

Significance of impact without mitigation measures: High

Proposed mitigation measures:

- A field assessment and full HIA as per section 38(3) of the NHRA is required to assess the actual heritage resources on the ground.

Significance of impact with mitigation measures:

- To be determined once the field assessment has been conducted.

1.6.2. Operational Phase

Nature of impact:

- Destruction of archaeological artefacts during operational activities or upgrades.
- Destruction of pastoralist cultural landscape of heritage and historical significance. A loss of ‘sense of place’.
- Destruction of palaeontological material (mainly of Precambrian Stromatolites) during operational activities or upgrades.

Significance of impact without mitigation measures: High

Proposed mitigation measures:

- The development of a Heritage Conservation Management Plan for the WEF to ensure that heritage resources are continuously managed throughout the operational phase.

Significance of impact with mitigation measures: Low

1.6.3. Cumulative Impacts

Nature of impact:
- Changes in the aesthetics of the cultural landscape.
- Destruction of heritage resources

Significance of impact without mitigation measures: High

Proposed mitigation measures:
- A field assessment and full HIA as per section 38(3) of the NHRA is required to assess the actual heritage resources on the ground

Significance of impact with mitigation measures:
- To be determined once the field assessment has been conducted.

1.7. RECOMMENDATIONS AND CONCLUSION

The heritage resources along the routes proposed for development are only partially recorded.

Based on the available information, the proposed development is likely to impact on heritage resources and as such, it is recommended that a complete Heritage Impact Assessment is required that assesses impacts to landscape character, secondary (and possibly primary) impacts on built environment resources, archaeological resources, graves and burial grounds, fossil heritage and mining heritage.

1.8. REFERENCES

Reference List

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
123045	AIA	Cobus Dreyer	26/06/2013	Report Eskom Garona Ferrum Mercury
152170	HIA	Robert de Jong	03/09/2008	Heritage Impact Assessment Report: Proposed Residential Development And Associated Infrastructure On A 200 Ha Portion Of The Farm Bestwood 429 Rd At Kathu, Northern Cape Province
152171	AIA	Cobus Dreyer	11/08/2008	First Phase Archaeological And Cultural Heritage Assessment Of The Proposed Residential Developments At A Portion Of The Remainder Of The Farm Bestwood 459rd, Kathu, Northern Cape
156617	AIA	David Morris	01/02/2014	Rectification and/or regularisation of activities relating to the Bestwood Township development near Kathu, Northern Cape: Phase 1 Archaeological Impact Assessment
163959	HIA	Anton van Vollenhoven	17/03/2014	HIA Eskom Manganore to Ferrum Scoping Phase
170455	AIA	Neels Kruger	31/03/2014	Archaeological Impact Assessment (aia) Of Demarcated Surface Portions On The Farms Sacha 468, Sims 462 And Sekgame 461 For The Proposed Stormwater Infrastructure (clean Water Cut-off Berm & Groundwater Dam) For The Sishen Mine, Kathu, Northern Cape Province.
170660	AIA	Cobus Dreyer	31/01/2014	First Phase Archaeological & Heritage Assessment Of the Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
170664	AIA	Cobus Dreyer	28/09/2012	First Phase Archaeological And Heritage Assessment Of the Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
170666	AIA	Cobus Dreyer	31/12/2013	First Phase Archaeological And Heritage Assessment Of The Proposed Vaal-gamagara Water Pipeline Project, Northern Cape
279906	AIA	Neels Kruger	02/12/2014	Archaeological Impact Assessment (aia) Of Demarcated Surface Portions On The Farm Sekgame 461 For The Proposed Sekgame Electricity Infrastructure Expansion Project, Sishen Mine, Northern Cape Province
294454	AIA	Neels Kruger	05/04/2015	Archaeological Impact Assessment (aia) Of Areas Demaracted For The Proposed Lyleveld North Waste Rock Dump Expansion And Lyleveld South Haul Road Extension Project, Sishen Mine, Northern Cape Province
324952	HIA	Lloyd Rossouw	07/07/2015	Phase 1 Heritage Impact Assessment of the 2.3 km long 40478 Vaal-Gamagara water pipeline alternative route around Kathu Pan, Northern Cape Province
329708	HIA	Anton van Vollenhoven	01/11/2014	HIA Eskom Manganore-Ferrum for EIA Phase
6339	AIA	David Halkett	24/08/2009	An archaeological scoping assessment of the remainder and portion 1 (Tierkop) of farm Bramcote 446, Northern Cape Priovince.

Palaeontological Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
114648	PIA	John E Almond	01/09/2012	Palaeontological Specialist Assessment: Desktop Study Proposed 16 Mtpa Expansion Of Transnet's Existing Manganese Ore Export Railway Line & Associated Infrastructure Between Hotazel And The Port Of Ngqura, Northern & Eastern Cape.

Web References
http://pza.sanbi.org/vegetation/nama-karoo-biome
http://pza.sanbi.org/vachellia-erioloba
http://pza.sanbi.org/sites/default/files/info_library/camelthorns_khathu_pdf.pdf
http://www.museumsnc.co.za/aboutus/depts/education/GuidePlants.pdf
https://www.sciencedirect.com/science/article/pii/S0195925509000857

1.9. APPENDICES

Table 1-1 Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Construction of roads and infrastructure related to the WEF.	Destruction of heritage resources including archaeology palaeontology and cultural landscape resources.	Negative	Site	Long-Term	Substantial	Very likely	Low	High	A field assessment and full HIA as per section 38(3) of the NHRA will be undertaken during the EIA phase to assess the actual heritage resources on site.	HIGH	Moderate	4	Medium

Table 1-2 Impact assessment summary table for the Operational Phase

Operational Phase													
Indirect Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Activities related to the WEF.	Destruction of heritage resources including archaeology palaeontology and cultural landscape resources	Negative	Site	Long-Term	Substantial	Likely	Low	High	Should there be any heritage resources found on site, the development of a Heritage Conservation Management Plan for the WEF is recommended to ensure that heritage resources are continuously managed throughout the operational phase.	HIGH	Low	3	Medium

Table 1-3 Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Construction of roads and infrastructure related to the WEF.	Destruction of heritage resources including archaeology palaeontology and cultural landscape resources.	Negative	Site	Long-Term	Substantial	Very likely	Low	High	A field assessment and full HIA as per section 38(3) of the NHRA will be undertaken during the EIA phase to assess the actual heritage resources on site.	HIGH	Moderate	4	Medium

SOILS AND AGRICULTURAL POTENTIAL ASSESSMENT:

for the Proposed Development of the Phase 2 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province: SCOPING REPORT

Report prepared for:
CSIR – Environmental Management Services
PO Box 320
Stellenbosch
7600

Report prepared by:
Johann Lanz – Soil Scientist
P.O. Box 6209
Stellenbosch, 7599
South Africa

26 April 2018

Johann Lanz
Curriculum Vitae

Education

M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1999
B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I am registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science, registration number 400268/12, and am a member of the Soil Science Society of South Africa.

Soil Science Consultant **Self employed** **2002 - present**

I run a soil science consulting business, servicing clients in both the environmental and agricultural industries. Typical consulting projects involve:

Soil specialist study inputs to EIA's, SEA's and EMPR's. These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: Aurecon; CSIR; SiVEST; SRK Consulting; Juwi Renewable Energies; Mainstream Renewable Power; Subsolar; Tiptrans; Planscape; Afrimat; Savannah Environmental; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Haw & Inglis.

Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Vogelfontein Citrus; De Grendel Estate; Zewenwacht Wine Estate; Goedgedacht Olives;, Lourensford Fruit Company; Kaarsten Boerdery; Wedderwill Estate; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.

I have conducted several research projects focused on conservation farming, soil health and carbon sequestration.

Soil Science Consultant **Agricultural Consultors International (Tinie du Preez)** **1998 - end 2001**

Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

Contracting Soil Scientist **De Beers Namaqualand Mines** **July 1997 - Jan 1998**

Completed a contract to make recommendations on soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

Specialist Declaration

I, Johann Lanz, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Name of Specialist: Johann Lanz

Signature of the specialist: 

Date: 26 April 2018

Executive summary

The proposed Kuruman Wind Farm Facility will be located on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed development is on land which is of low agricultural potential and is unsuitable for cultivation.

The key findings of this study are:

- Soils of the proposed wind farm site are dominated by rock outcrops and shallow, sandy, red soils on underlying rock, which are of the Hutton soil form.
- The major limitations to agriculture are the shallow, rocky soils and the limited climatic moisture availability.
- As a result of these limitations, the study area is totally unsuitable for cultivation and agricultural land use is limited to grazing.
- The predominant land capability is classified as Class 8 - non-utilisable, wilderness land.
- There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development.
- The significance of all agricultural impacts is kept low by two important factors. The first is that the actual footprint of disturbance of the wind farm constitutes only a very small proportion of the available grazing land. The second is the fact that the proposed site is on land of limited agricultural potential that is only viable for grazing.
- Five potential negative impacts of the development on agricultural resources and productivity were identified as:
    - Loss of agricultural land use on the minimal footprint of the development caused by direct occupation of infrastructure;
    - Loss of topsoil in disturbed areas, causing a decline in soil fertility;
    - Soil Erosion caused by alteration of the surface characteristics;
    - Degradation of veld vegetation beyond the direct development footprint;
    - Cumulative regional loss of agricultural land use and potential.
- One potential positive impact of the development on agricultural resources and productivity was identified as:
    - Generation of alternative / additional land use income through the wind farm, which will improve cash flow and financial sustainability of farming enterprises on site.
- All impacts were assessed as having low or very low significance.
- Cumulative impact is also assessed as low. Furthermore it is far more preferable to incur a loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development elsewhere in the country.
- Recommended mitigation measures include implementation of an effective system of storm

water run-off control and the maintenance of vegetation cover to mitigate erosion; topsoil stripping and re-spreading to mitigate loss of topsoil; restricted vehicle access; and dust control.

- Due to the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.
- There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation, should this be granted.
- The overall significance of the impact on agriculture for the construction, operation and decommissioning phase is assessed as **very low**.

Table of Contents

List of Figures

List of Tables

Compliance with the Appendix 6 of the 2014 EIA Regulations (as Amended)

Requirements of Appendix 6 – GN R326 EIA Regulations 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	 Title page CV in the beginning of report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 3
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1.1 & 1.1.2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.1.5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.3.6 & 1.6.4
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1.1.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.1.3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.3.4, 1.3.8 & Figure 3
g) an identification of any areas to be avoided, including buffers;	Section 1.3.8
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 3, Section 1.3.4
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 1.6
k) any mitigation measures for inclusion in the EMPr;	Section 1.8
l) any conditions for inclusion in the environmental authorisation;	Section 1.9.2
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 1.8
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	 Section 1.9 Section 1.8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable

1.1 Introduction and methodology

1.1.1 Scope and objectives

This report presents the Soil and Agricultural Potential Assessment undertaken by Mr. Johann Lanz (an independent consultant), appointment by the CSIR, as part of the Environmental Impact Assessment for the proposed development of the Kuruman Wind Farm near Kuruman, Northern Cape Province (see Figure 1.)

The objectives of the study are to identify and assess all potential impacts of the proposed development on agricultural resources including soils and agricultural production potential, and to provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified potential impacts.

Figure 1. *Location of the proposed Kuruman Wind Farm Facility, south of Kuruman in the Northern Cape.*

1.1.2 Terms of Reference

The following Terms of Reference (ToR) apply to this study:

The report fulfils the ToR for an agricultural study as set out in the National Department of Agriculture's document, *Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011. DEA's requirements for an agricultural study are taken directly from this document, but use an older version of the document and not the most recent version, which was updated in 2011.

The study applies an appropriate level of detail for the agricultural suitability on site and for the level of impact of the proposed development on agricultural land. A detailed soil survey, as per the requirement in the above document, is appropriate for a significant footprint of impact on arable land. It is not appropriate for this site, where soil and climate constraints make cultivation completely non-viable. Conducting a soil survey at the required level of detail would be very time consuming but would also be unnecessary as it would add no value to the impact assessment. The level of soil assessment that was conducted for this report (reconnaissance ground proofing of land type data) is considered more than adequate for a thorough assessment of all agricultural impacts.

The above requirements together with requirements for an EIA specialist report may be summarised as follow:

- Based on existing data as well as a field soil survey, describe and map soil types (soil forms) and characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers).
- Describe the topography of the site.
- Describe historical and current land use, agricultural infrastructure, as well as possible alternative land use options.
- Describe the erosion, vegetation and degradation status of the land.
- Determine and map the agricultural potential across the site.
- Determine and map the agricultural sensitivity to development across the site, including “no-go” areas, setbacks/buffers, as well as any red flags or risks associated with soil and agricultural impacts.
- Identify relevant legislation and legal requirements relating to soil and agricultural potential impacts.
- Identify and assess all potential impacts (direct, indirect and cumulative) of the construction, operational and decommissioning phases of the proposed development on soils and agricultural potential, and note the economic consequences of the proposed development on soils and agricultural potential.
- Provide recommended mitigation measures, management actions, monitoring requirements,

and rehabilitation guidelines for all identified impacts.

1.1.3 Approach and Methodology

The pre-fieldwork assessment was based on the existing Agricultural Geo-Referenced Information System (AGIS) data, as well as Google Earth satellite imagery for the site. The AGIS data was supplemented by a field investigation. This was aimed at ground-proofing the AGIS data and achieving an understanding of specific soil and agricultural conditions, and the variation of these across the site. The field investigation involved a drive and walk over of the site using assessment of surface conditions and existing exposures. The field assessment was done on 20 February 2018, during summer. An assessment of soils (soil mapping) and long term agricultural potential is in no way affected by the season in which the assessment is made, and the timing of the assessment therefore has no bearing on its results. Soils were classified according to Soil Classification Working Group (1991).

The field investigation also included a visual assessment of erosion and erosion potential on site, taking into account a probable development layout. The level of field investigation for this assessment is considered more than adequate for the purposes of this study (see section 1.1.2).

The potential impacts identified in this specialist study have been assessed based on the criteria and methodology outlined in Chapter 4 of the Draft EIA Report. The ratings of impacts are based on the specialist's knowledge and experience of the field conditions and the impact of disturbances on those.

1.1.4 Assumptions, knowledge gaps and Limitations

The following assumptions were used in this specialist study:

- The study assumes that water for irrigation is not available across the site. This is based on the assumption that a long history of farming experience in an area will result in the exploitation of viable water sources if they exist, and none have been exploited in this area.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Appendix B.

The following limitation was identified in this study:

- The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist, but is done with due regard and as accurately as possible within these constraints.

There are no other specific limitations or knowledge gaps relevant to this study.

1.1.5 Source of information

All data on land types, land capability, grazing capacity etc. was sourced from the online Agricultural Geo-Referenced Information System (AGIS), produced by the Institute of Soil, Climate and Water (Agricultural Research Council, 2007). Current and historical satellite imagery was all sourced from Google Earth. Rainfall and temperature data was sourced from The World Bank Climate Change Knowledge Portal (2015).

Soil data on AGIS originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.

1.2 Applicable legislation and permit requirements

A change of land use (re-zoning) for the development on agricultural land needs to be approved in terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA). This is required for long term lease, even if no subdivision is required. Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). No application is required in terms of CARA. The EIA process covers the required aspects of this. The Department of Agriculture, Forestry and Fisheries (DAFF) reviews and approves applications in terms of these Acts according to their *Guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land*, dated September 2011.

1.3 Description of the affected environment: Soils and agricultural capability

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 1.1.2 of this report.

A satellite image map of the study site is given in Figure 3 and photographs of site conditions are given in Figures 4 to 7.

1.3.1 Climate and water availability

The site has a low rainfall of 400 mm per annum (The World Bank Climate Change Knowledge Portal, 2015). The average monthly rainfall distribution is shown in Figure 2. The low rainfall is a significant agricultural constraint that limits the level of agricultural production (including grazing) which is

possible.

There are wind pumps with stock watering points across the area, but no other water or water storage infrastructure.

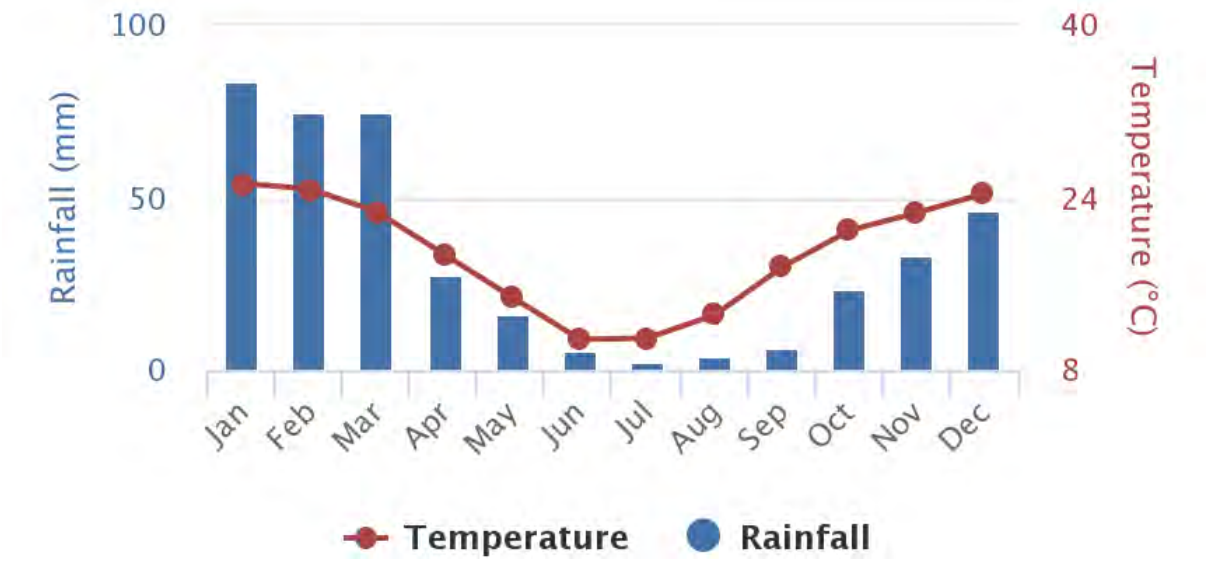


Figure 2. *Average monthly temperature and rainfall for location (-27.59, 23.40), which is on the site, from 1991 – 2015 (The World Bank Climate Change Knowledge Portal, 2015).*

1.3.2 Terrain, topography and drainage

The turbines of the proposed development are located on a series of hilly, north-south running ridges which rise from the plateau, at an altitude of approximately 1,400 metres, to a maximum altitude of over 1,700 meters. Slopes vary across the area, with maximum slopes of 35% down the sides of the ridges where they are steepest. The maximum slopes that would be impacted by any project footprint are however much less and are not likely to exceed 15%.

The underlying geology of the area is yellow-brown banded or massive jaspilite with crocidolite, and banded ironstone with subordinate amphibolite, crocidolite and ferruginous brecciated banded ironstone.

No perennial drainage features occur on the site, but there are non-perennial drainage lines in the valley bottoms

1.3.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and

climatic conditions into different land types. There is predominantly only one land type, Ib236, across the hilly terrain of the site, with a second, Ae2, extending a small distance into the site on flatter land in the extreme east.

Land type Ib236 is dominated (71% of the surface) by rock outcrop. The soils between the rock outcrops are red, sandy soils on underlying hard rock, of the Hutton soil form. They are predominantly shallow, but patches of deeper sands occur. The soils of Ae2 are shallow to deep, red, sandy soils on underlying rock or hardpan carbonate and are of the Hutton or Plooysburg soil forms. The soils would fall into the Oxidic and Calcic (underlying hardpan carbonate) soil groups according to the classification of Fey (2010). A summary detailing soil data for the land types is provided in Appendix B, Table B1. The field investigation confirmed that the dominant soil types are as described in the land type data.

The environment does not pose a particularly high erosion risk. Mitigating factors are the rock outcrops, permeability of the sandy soils and adequate vegetation cover. However, any surface disturbance always poses an erosion risk. Because the soils have a sandy texture, they are susceptible to wind erosion.

1.3.4 Agricultural capability

Land capability is the combination of soil suitability and climate factors. Land type Ib236, which is almost all of the site, is classified as Class 8 – non-utilisable wilderness land. The small portion of land type Ae2 included in the site is classified as Class 5, which is non-arable, moderate potential grazing land. Limitations to agriculture are predominantly the shallow, rocky soils, but in the patches of deeper soils, agriculture is still very limited by the climatic moisture availability.

The grazing capacity of the area is classified at approximately 20 hectares per large stock unit.

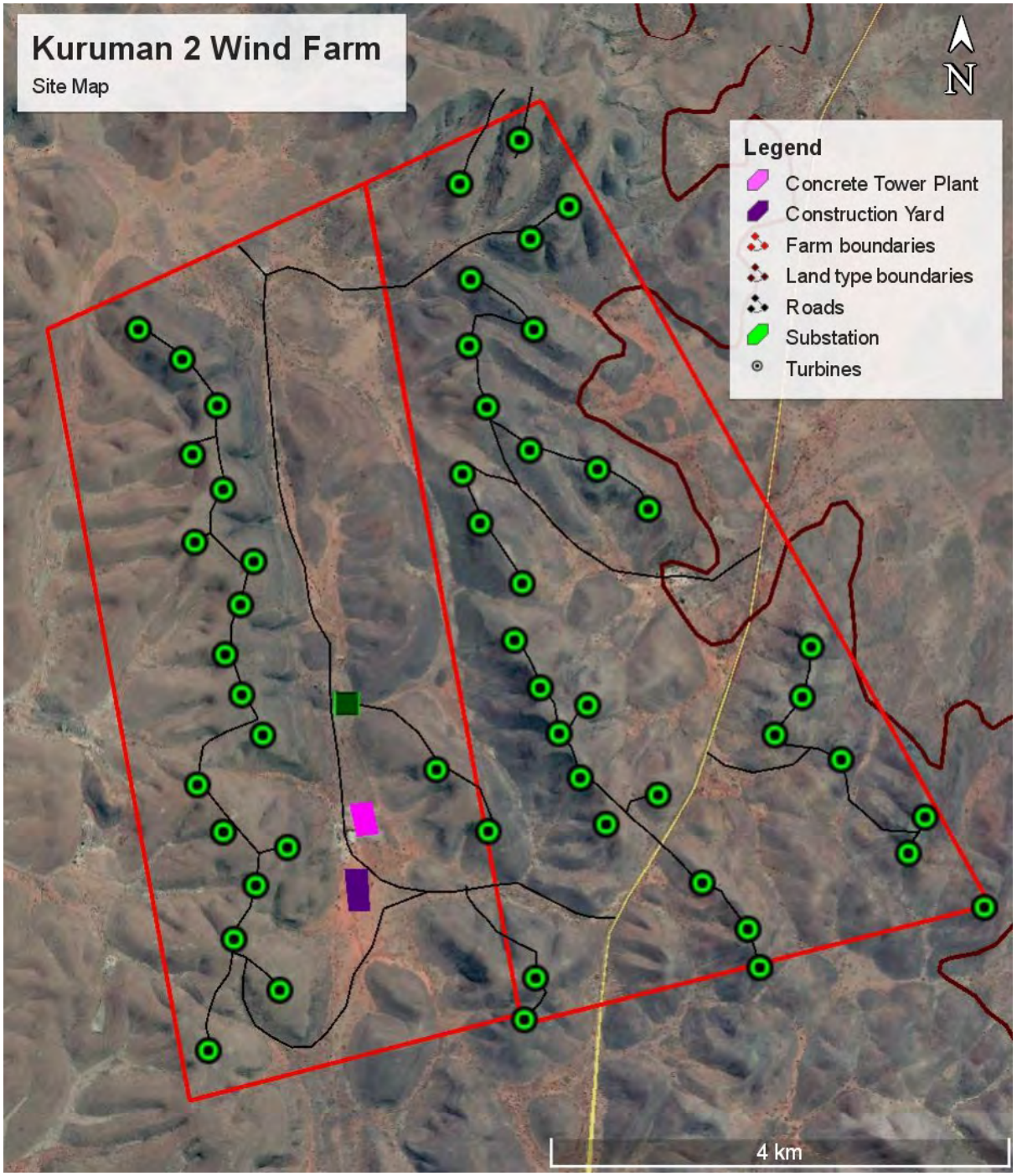


Figure 3. *Satellite image site map of the proposed Kuruman 2 Wind Farm showing land type distribution.*

Figure 4. *Photograph showing typical landscape and veld conditions of the proposed wind farm site. Turbines will be restricted to the tops of the higher lying hills and ridges.*

Figure 5. *Photograph showing typical landscape and veld conditions of the proposed wind farm site. The commonly occurring rock outcrops are clearly visible in the foreground.*

Figure 6. *Photograph showing landscape and veld conditions within the valleys of the proposed wind farm site. This photograph shows that rock outcrops also occur in the low lying landscape positions, not only on the higher ground. Some wind farm support infrastructure will be located in the valleys, but most infrastructure will be located on the hills and ridges.*

Figure 7. *Photograph showing the typical red, sandy soils that occur between rock outcrops on the proposed wind farm site.*

1.3.5 Land use and development on and surrounding the site

The area is a cattle farming area. The climate does not support any cultivation and grazing is the only viable agricultural activity. The only agricultural infrastructure present on site are wind pumps, stock watering points and fencing surrounding grazing camps. There are two farmsteads located in two different valleys within the study area.

Access to the site is by way of farm access roads off the nearest public road to the south east.

1.3.6 Status of the land

The vegetation has been grazed but there is no significant erosion or other land degradation on the site.

1.3.7 Possible land use options for the site

The low climatic moisture availability and shallow, rocky soils mean that grazing is the only possible agricultural land use for the site.

1.3.8 Agricultural sensitivity

Agricultural potential and conditions are very uniform across the site and the choice of placement of facility infrastructure, including access roads and transmission lines therefore has minimal influence on the significance of agricultural impacts. No sensitive agricultural areas occur within the study area. From an agricultural point of view, no parts of the site need to be avoided by the proposed development and no buffers are required.

1.4 Description of project aspects relevant to agricultural impacts

The components of the project that can impact on soils, agricultural resources and productivity are:

- Occupation of the land by the total physical footprint of the proposed project including all turbines, hard stands, roads and electrical infrastructure.
- Construction activities that may disturb the soil profile and vegetation, for example for levelling, excavations, etc.

The facility will comprise the following infrastructure:

- Turbines with foundations;

- Hard standing areas for crane usage per turbine;
- Internal gravel roads linking turbine locations.
- On-site substation;
- Operation and maintenance building;
- Concrete tower plant;
- Temporary site offices, construction camp area, and lay down areas;
- Cabling between turbines to be laid underground wherever practical; and
- Stormwater channels and culverts.

1.5 Identification of key issues

1.5.1 Identification of potential impacts

The potential impacts identified during the assessment are:

1.5.1.1 Construction phase

- Loss of agricultural land use;
- Soil erosion;
- Loss of topsoil; and
- Degradation of veld vegetation.

1.5.1.2 Operational phase

- Loss of agricultural land use;
- Generation of alternative land use income; and
- Soil erosion.

1.5.1.3 Decommissioning phase

- Loss of agricultural land use;
- Soil erosion;
- Loss of topsoil; and
- Degradation of veld vegetation.

1.5.1.4 Cumulative impact

- Regional loss of agricultural land.

1.6 Assessment of impacts and identification of management actions

The significance of all potential agricultural impacts is low due to two important factors.

1. The actual footprint of disturbance of the wind farm (including associated infrastructure and roads) is very small in relation to the land available for grazing on the affected farm portions (<2% of the surface area). All agricultural activities will be able to continue unaffectedly on all parts of the farm other than the small development footprint for the duration of and after the project.
2. The proposed site is on land of limited agricultural potential that is only viable for grazing. These factors also mean that cumulative regional effects as a result of other surrounding developments, also have low significance.

All identified impacts are considered to be direct impacts. No indirect impacts were identified.

1.6.1 Construction phase

1.6.1.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use is due to direct occupation of small portions of land by development infrastructure. It results in affected, portions of land being taken out of agricultural production. This applies only to the direct footprint of the development which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure. This represents a small proportion of the land surface area. During the construction phase there will be slightly more disturbance, due to temporary lay down areas and construction camps.
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not applicable

1.6.1.2 Soil erosion

Aspect / Activity	Change in land surface characteristics.
Type of impact	Direct
Potential Impact	Erosion may be by wind or water. It can occur as a result of the alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by

	construction related land surface disturbance, vegetation removal, the establishment of hard standing areas and roads. Erosion will cause loss and deterioration of soil resources. Erosion can be effectively managed through mitigation measures.
Mitigation Required	Implement an effective system of storm water run-off control. Maintain, where possible, all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.1.3 Loss of topsoil

Aspect / Activity	Activities that disturb the soil profile.
Type of impact	Direct
Potential Impact	Loss of topsoil can result from poor topsoil management (burial, erosion, etc) during construction related soil profile disturbance (levelling, excavations, road surfacing etc.). It will result in a decrease in the soil's capability for supporting vegetation.
Mitigation Required	Strip, stockpile and re-spread topsoil during rehabilitation.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.1.4 Degradation of veld vegetation

Aspect / Activity	Vehicle traffic and dust generation
Type of impact	Direct
Potential Impact	Degradation of veld vegetation can occur beyond the direct footprint of the development due to vehicle trampling and dust deposition.
Mitigation Required	Control vehicle passage and control dust
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.2 Operational phase

1.6.2.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use is due to direct occupation of the land by all development infrastructure. It results in affected portions of land being taken out of agricultural production. This applies to the direct footprint of the development which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure. This represents a small proportion of the land surface area.
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Not applicable

1.6.2.2 Soil erosion

Aspect / Activity	Change in land surface characteristics.
Type of impact	Direct
Potential Impact	Erosion may be by wind or water. It can occur as a result of the alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by construction related land surface disturbance, vegetation removal, the establishment of hard standing areas and roads. Erosion will cause loss and deterioration of soil resources. Erosion can be effectively managed through mitigation measures.
Mitigation Required	Implement an effective system of storm water run-off control. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.2.3 Additional land use income

Aspect / Activity	Project land rental
Type of impact	Direct

Potential Impact	This is a positive impact for agriculture. Alternative / additional land use income will be generated by the farming enterprise through the lease of the land for the WEF. This will provide the farming enterprise with increased cash flow and rural livelihood, and thereby improve its financial sustainability.
Mitigation Required	None
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not Applicable

1.6.3 Decommissioning phase

1.6.3.1 Loss of agricultural land use

Aspect / Activity	Occupation of the land by the project infrastructure
Type of impact	Direct
Potential Impact	Loss of agricultural land use is due to direct occupation of the land by all development infrastructure. It results in affected portions of land being taken out of agricultural production. This applies to the direct footprint of the development which comprises the turbine foundations, hard standing areas, roads and the footprint of other infrastructure. This represents a small proportion of the land surface area. During the decommissioning phase there is more disturbance.
Mitigation Required	None possible
Impact Significance (Pre-mitigation)	Low
Impact Significance (Post-Mitigation)	Not applicable

1.6.3.2 Soil erosion

Aspect / Activity	Change in land surface characteristics.
Type of impact	Direct
Potential Impact	Erosion may be by wind or water. It can occur as a result of the alteration of the land surface run-off characteristics. Alteration of run-off characteristics may be caused by construction related land surface disturbance, vegetation removal, the establishment of hard standing areas and roads. Erosion will cause loss and deterioration of soil resources. Erosion can be effectively managed through mitigation measures.

Mitigation Required	Implement an effective system of storm water run-off control. Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.3.3 Loss of topsoil

Aspect / Activity	Activities that disturb the soil profile.
Type of impact	Direct
Potential Impact	Loss of topsoil can result from poor topsoil management (burial, erosion, etc) during construction related soil profile disturbance (levelling, excavations, road surfacing etc.). It will result in a decrease in the soil's capability for supporting vegetation.
Mitigation Required	Strip, stockpile and re-spread topsoil during rehabilitation.
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.3.4 Degradation of veld vegetation

Aspect / Activity	Vehicle traffic and dust generation
Type of impact	Direct
Potential Impact	Degradation of veld vegetation can occur beyond the direct footprint of the development due to vehicle trampling and dust deposition.
Mitigation Required	Control vehicle passage and control dust
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.6.4 Cumulative impacts

Cumulative impact has been assessed by consideration of all renewable energy developments within 50 km of this development (see Appendix B). The cumulative impact is a regional loss of agricultural land. The impact is low because of the limited agricultural potential of all land in the area,

predominantly as a result of climatic limitations. There is no particular scarcity of such land in South Africa. Furthermore the footprint of disturbance of wind farms is very small in relation to available land (<2% of surface area). Therefore even if all farm portions in an area contained wind farms, the total cumulative footprint would never exceed 2%. In reality the cumulative impact across the landscape is much lower because only a small percentage of farms is actually occupied by wind farms.

In addition, it is preferable to incur a cumulative loss of agricultural land in such a region, without cultivation potential, than to lose agricultural land that has a higher potential, to renewable energy development, elsewhere in the country.

The cumulative impact is assessed in table format below.

Aspect / Activity	Occupation of the land by the project infrastructure of multiple developments
Type of impact	Direct
Potential Impact	Cumulative impacts are likely to occur as a result of the regional loss of agricultural land and production because of other developments on agricultural land in the region. Because the proportion of the land surface that is lost is so small, and because the land is of low agricultural potential, the cumulative loss of agricultural resources is of low significance.
Mitigation Required	None
Impact Significance (Pre-mitigation)	Very low
Impact Significance (Post-Mitigation)	Very low

1.7 Impact assessment summary

Table 1. *Impact assessment summary table - Construction phase direct impacts*

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Moderate	Very Likely	Low	Low	Low	No	No	None	Not applicable	4	High
Change in land surface characteristics.	Erosion	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Implement an effective system of storm water run-off control. Maintain vegetation cover.	Very low	5	High
Constructio activities that disturb the soil profile.	Loss of topsoil	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Strip, stockpile and re-spread topsoil during rehabilitation.	Very low	5	High
Vehicle traffic and dust generation	Degradation of veld vegetation	Negative	Site	Short term	Slight	Unlikely	Low	Low	Very Low	No	Yes	Control vehicle passage and control dust	Very Low	5	High

Table 2. *Impact assessment summary table - Operational phase direct impacts*

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Slight	Very Likely	Low	Low	Very low	No	No	None	Not applicable	5	High
Change in land surface characteristics.	Erosion	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Implement an effective system of storm water run-off control. Maintain vegetation cover.	Very low	5	High
Project land rental	Additional land use income	Positive	Site	Long term	Moderate	Very Likely	High	Low	Low	No	No	None	Not applicable	4	High

Table 3. *Impact assessment summary table - Decommissioning phase direct impacts*

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure	Loss of agricultural land use	Negative	Site	Short term	Moderate	Very Likely	Low	Low	Low	No	No	None	Not applicable	4	High
Change in land surface characteristics.	Erosion	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Implement an effective system of storm water run-off control. Maintain vegetation cover.	Very low	5	High
Constructional activities that disturb the soil profile.	Loss of topsoil	Negative	Site	Medium term	Slight	Unlikely	Low	Low	Very low	No	Yes	Strip, stockpile and re-spread topsoil during rehabilitation.	Very low	5	High
Vehicle traffic and dust generation	Degradation of veld vegetation	Negative	Site	Short term	Slight	Unlikely	Low	Low	Very Low	No	Yes	Control vehicle passage and control dust	Very Low	5	High

Table 4. *Impact assessment summary table - Cumulative impacts*

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/impact (after mitigation)	Ranking of impact/ risk	Confidence level
Occupation of the land by the project infrastructure of multiple developments	Regional loss of agricultural land	Negative	Regional	Long term	Slight	Very Likely	High	Low	Very low	No	No	None	Not applicable	5	High

1.8 Input to the Environmental Management Programme (EMPr)

The following mitigation measures are proposed for inclusion in the EMPr:

- Implement an effective system of storm water run-off control using bunds and ditches, where it is required - that is at points where water accumulation might occur. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion.
- Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize the soil against erosion.
- If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. Topsoil stockpiles must be conserved against losses through erosion by establishing vegetation cover on them. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface. Any subsurface spoils from excavations must be disposed of where they will not bury the topsoil of agricultural land.
- Restrict vehicle access to approved roads and areas only.
- Control dust generation during construction activities by implementing standard construction site dust control measures of damping down with water where dust generation occurs.

The following monitoring requirements are proposed for inclusion in the EMPr:

- Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.
- Establish an effective record keeping system for each area where soil is disturbed for construction and decommissioning purposes. Recommendations for the recording system are included in the EMPr.
- Undertake a periodic site inspection during construction to check for vehicle tracks beyond the approved vehicle areas.

1.9 Conclusions and recommendations

The proposed development is located on land zoned and used for agriculture. South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of potentially arable land. The assessment has found that the proposed development will only impact agricultural land which is of low agricultural potential and only suitable for grazing.

The significance of all agricultural impacts is low due to two important factors. Firstly, the actual footprint of disturbance of the wind farm (including associated infrastructure and roads) is very small in relation to the available grazing land on the effected farm portions (<2% of the surface area). All agricultural activities will be able to continue unaffectedly on all parts of the farm other than the small development footprint for the duration of and after the project. Secondly, the proposed site is on land of limited agricultural potential that is only viable for grazing. These two factors also mean that cumulative regional effects as a result of other surrounding developments, also have low significance.

There are no agriculturally sensitive areas that need to be avoided by the development.

1.9.1 Final statement by the specialist - should the proposed activities be authorised?

Due to the low agricultural potential of the site, and the consequent low agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.

1.9.2 Recommended conditions to be included in the environmental authorisation

There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation should this be granted.

2 References

Agricultural Research Council. 2007. AGIS Agricultural Geo-Referenced Information System available at http://www.agis.agric.za/.

Fey, M. 2010. Soils of South Africa. Cambridge University Press, Cape Town.

Soil Classification Working Group. 1991. Soil classification: a taxonomic system for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

The World Bank Climate Change Knowledge Portal available at http://sdwebx.worldbank.org/climateportal/

Appendix A: Soil data

Table A1. *Land type soil data for site.*

Land type	Land capability class	Soil series (forms)	Depth (mm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Ib236	8	Rock outcrop					71
		Hutton	50 - 300	2 - 6	4 - 10	R	22
		Hutton	300 - 1200	2 - 6	4 - 10	R	6
Ae2	5	Hutton	600 > 1200	2 - 6	4 - 10	R	26
		Hutton	750 > 1200	2 - 6	4 - 9	R,ka	23
		Hutton	300 - 600	2 - 6	4 - 10	R	16
		Hutton	100 - 300	4 - 8	4 - 10	R	15
		Hutton	300 - 600	2 - 6	4 - 9	R,ka	10
		Rock outcrop					4
		Hutton	450 - 750	10 - 15	15 - 20	R,ka	2
		Clovelly	750 - 1200	2 - 6	4 - 10	ka	1
		Mispah	50 - 250	4 - 10		ka	1

Land capability classes: 5 = non-arable, moderate potential grazing land; 8 = non-utilisable wilderness land.
Depth limiting layers: R = hard rock; ka = hardpan carbonate.

Appendix B: Projects to be considered in terms of cumulative impacts

DEA_REF	PROJ_TITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT
14/12/16/3/3/2/819	The 75 MW AEP Legoko Photovoltaic Solar Facility on Portion 2 of the Farm Legoko 460, Kuruman Rd within the Gamagara Local Municipality in the Northern Cape Province	AEP Lekogo Solar (Pty) Ltd	Cape Environmental Assessment Practitioners	Solar PV	75
14/12/16/3/3/2/820	The 75 MW AEP Mogobe Photovoltaic Solar Facility on portion 1 of the farm Legoko 460 and farm Sekgame 461, Kuruman Rd within the Gamagara Local Municipality in the Northern Cape Province	AEP Mogobe Solar (Pty) Ltd	Cape Environmental Assessment Practitioners	Solar PV	75
12/12/20/1858/1	Kathu Solar Energy Facility	Renewable Energy Investments South Africa Pty Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	75
12/12/20/1858/2	Kathu Solar Energy Facility 25MW 2	Lokian Trading and Investments	Savannah Environmental Consultants (Pty) Ltd	Solar PV	25
12/12/20/1860	Proposed establishment of the Sishen Solar Farm on Portion 6 of Wincanton 472, NC	VentuSA Energy Pty Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	74
12/12/20/1906	Proposed construction of solar farm for Bestwood, Kgalagadi District Municipality, NC	Katu Property Developers Pty Ltd	Rock Environmental Consulting (Pty) Ltd	Solar PV	0
12/12/20/1994 12/12/20/1994/1 12/12/20/1994/2 12/12/20/1994/3	The Proposed Construction Of Kalahari Solar Power Project On The Farm Kathu 465, Northern Cape Province	Group Five Pty Ltd	WSP Environmental (Pty) Ltd	Solar PV	480
12/12/20/2566	A 19MW Photovoltaic Solar Power Generation Plant On The Farm Adams 328 Near Hotazel, Northern Cape Province	To review	To review	Solar PV	19
12/12/20/2567	The Proposed 150mw Adams Photo-Voltaic Solar Energy Facility On The Farm Adams 328 Near Hotazel Northern Cape Province	To review	To review	Solar PV	75
14/12/16/3/3/1/474	Construction of the Roma Energy Mount Roper Solar	To review	EnviroAfrica Environmental	Solar PV	10

DEA_REF	PROJ_TITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT
	Plant on the Farm Moutn Roper 321, Kuruman, Ga-Segonyana Local Municipality		Consultants (Pty) Ltd		
14/12/16/3/3/1/475	The Proposed Construction Of Keren Energy Whitebank Solar Plant On Farm Whitebank 379, Kuruman, Northern Cape Province	To review	EnviroAfrica Environmental Consultants (Pty) Ltd	Solar PV	10
14/12/16/3/3/2/273	The Proposed San Solar Energy Facility And Associated Infrastructure On A Site Near Kathu, Gamagara Local Municipality, Northern Cape Province	To review	Savannah Environmental Consultants (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/616	Proposed renewable energy geneartion project on Portion 1 of the Farm Shirley No. 367, Kuruman RD, Gamagara Local Municipality, Shirley Solar Park	Danax Energy (Pty) Ltd	AGES Limpopo (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/761	Proposed 75 MW Perth-Kuruman Solar Farm on the remainder of the farm Perth 276 within the Joe Morolong Local Municipality, Northern Cape Province	Agulhas-Hotazel Solar Power (Pty) Ltd	Strategic Environmental Focus (Pty) Ltd	Solar PV	75
14/12/16/3/3/2/762	The 75MW Perth-Hotazel Solar Farm and its associated infrastructure on the Remainder of the Farm Perth 276 within the Joe Morolong Local Municipality in Northern Cape Province	Agulhus-Hotazel Solar Power (Pty) Ltd	Strategic Environmental Focus	Solar PV	75
14/12/16/3/3/2/911	Proposed 75MW AEP Kathu Solar PV Energy Facility on the Remainder of the Farm 460 Legoko near Kathu within the Gamagara local Municipality in the Northern Cape Province	AEP Kathu Solar (Pty) Ltd	Cape Eprac	Solar PV	75
14/12/16/3/3/2/934	Kagiso Solar Power Plant near Hotazel, Northern Cape Province	Kagiso Solar Power Plant (RF) (Pty) Ltd	Environamics	Solar PV	115
14/12/16/3/3/2/935	Proposed 115 Megawatt (MW) Boitshoko Solar Power Plant on the Remaining Extent of Portion 1 of The Farm Lime Bank no. 471 Near Kathu in the Gamagara Local Municipality	Boitshoko Solar Power Plant (RF) (Pty) Ltd	Environamics cc	Solar PV	115
14/12/16/3/3/2/936	Tshepo Solar Power Plant near Hotazel, Northern Cape	Tshepo Solar Power Plant (RF) (Pty) Ltd	Environamics cc	Solar PV	115

Socio-Economic Impact Study:

for the Proposed Development of the Phase 1 and Phase 2 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province: SCOPING REPORT

Report prepared for:

CSIR – Environmental Management Services

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19 March 2018

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Brief Profile: Ndivhuwo Malemagoba completed her MSc in Development Planning at the University of the Witwatersrand in 2016. In addition, she acquired her BSc and BSc (Hons) in Urban and Regional Planning at the same university in 2013 and 2014 respectively. She completed her BSc (Hons) degree with distinction. During her post-graduate studies, she attained Post-Graduate Merit Awards as a recognition of her outstanding academic record.

Ndivhuwo is a Development Economist with a sturdy background in development planning. Her endeavours include project management in built environment solution provision. Her robust experience in qualitative and quantitative research has equipped her with data collection, analysis and interpretation skills. This has led to her contribution to numerous development research studies in the academic and private sector arena.

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University of the Witwatersrand- 2016	MSc (Development Planning)
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University of the Witwatersrand - 2013	BSc (Urban and Regional Planning)
Mondeor High School-2009	National Senior Certificate

SPECIALIST DECLARATION

I, Elena Broughton, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of Specialist: Elena Broughton

Date: 19 March 2018

SPECIALIST DECLARATION

I, Ndivhuwo Malemagoba, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
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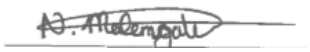
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of Specialist: Ndivhuwo Malemagoba

Date: 15 March 2015

LIST OF ABBREVIATIONS

DEA	Department of Environmental Affairs
CAGR	Compounded Annual Growth Rate
CAPEX	Capital Expenditure
DM	District Municipality
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
HV	High Voltage
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IRP	Integrated Resource Plan
LM	Local Municipality
MV	Medium Voltage
MW	Megawatt
NDP	National Development Plan
NGPF	New Growth Path Framework
OPEX	Operating Expenditure
PV	Photovoltaic
SDF	Spatial Development Framework

GLOSSARY

Definitions	
Not Economically Active	The portion of the population who are neither employed nor unemployed but include discouraged job seekers.
Gross Domestic Product	The sum of value added created by all residents within a certain period, which is commonly a year.
Working Age Population	The portion of the population aged between 15 and 64.
Compounded Annual Growth Rate	A measure of growth over multiple time periods.
Capital Expenditure	The cost of developing or providing non-consumable parts for the product or system.
Operating Expenditure	Ongoing costs for running a product, business or system.

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Socio-Economic Impact Study

1 INTRODUCTION AND METHODOLOGY

5.1 Scope and Objectives

This document is prepared by **Urban-Econ Development Economists** (Urban-Econ) in response to a request by the **CSIR** (Council for Scientific and Industrial Research) to undertake a scoping assessment for the proposed Kuruman Wind Farm Facility near Kuruman, in the Northern Cape.

The purpose of the Scoping Report is to determine the status of the socio-economic environment and identify preliminary key issues and potential impacts of the proposed project. The report is prepared as part of the socio-economic study and is used as input into the scoping report that is compiled by the CSIR. The scoping phase inputs address only a portion of the scope of the work involved in the socio-economic impact assessment and enable the project team and the client to make more informed decisions regarding the way forward for the proposed project, from an environmental management point of view.

5.2 Terms of Reference

- Undertake a policy review and assess the alignment of the proposed project with the national, provincial, and local socio-economic policies
- Create a socio-economic profile for the study area using indirect data
- Identify potential negative and positive socio-economic impacts that could be generated by the proposed site during the project life cycle
- Identify impacts and project effects (direct, indirect, and cumulative) that will require further investigation and recommend an approach for perusal during the EIA phase for completion of the impact assessment exercise
- Identify gaps in knowledge and data that will need to be addressed during the EIA phase

5.3 Approach and Methodology

1. Orientation
Aim: gain understanding of project during various stages of its life cycle
- Review of data and maps to inform delineation of the zone of influence

2. Policy review
Aim: determine policy alignment and highlight red flags
- Review relevant national, provincial and local government policies and startegic plans

3. Baseline profiling
Aim: establish a profile of communities that may be affected
- Gather primary and secondary data related to the zone of influence of the project
- Focus on the potentially affected area

4. Identification of anticipated impacts
Aim: assess and rate potential impacts to inform the EIA phase study
- Identify and rate potential socio-economic impacts
- Outline way forward with respect to data collection and in-depth analysis

Figure 1: Project Purpose and Methodology

The season of the site investigation does not have an effect on the outcomes of the study as data gained from the interviews is representative of all seasons throughout the year (i.e. economic activity during

different seasons is obtained). Furthermore, the study does not conduct any tests on site that may be affected by the season of investigation.

5.4 Assumptions and Limitations

- The secondary data sources used to compile the socio-economic baseline (demographics, dynamics of the economy), although not exhaustive, can be viewed as being indicative of broad trends within the study area.
- The study was done with the information available to the specialist within the time frames and budget specified.
- Possible impacts and stakeholder responses to these impacts cannot be predicted with complete accuracy, even when circumstances are similar, and these predictions are based on research and years of experience, taking the specific set of circumstances into account.
- It is assumed that the motivation and ensuing planning and feasibility studies for the project were done with integrity and that all information provided to the specialist by the project proponent and its consultants to date is accurate.
- With regard to the telephonic and email interviews undertaken, the following assumptions are made:
- Questions asked during the interviews were answered accurately.
- The adjacent land owners could not be contacted due to limited contact information; therefore, their views are not represented in this phase. However, their input will be presented in the next EIA phase.
- The limitation of this is that the views and issues identified are solely based on the baseline data of the environment and the views of the directly impacted land owners. Therefore, a holistic perspective of landowners' concerns has not been fully represented.
- The implication for the study is that there are gaps that will be filled within the next phase. Nonetheless, the critical data has been attained and the study remains accurate and achieves the objectives.

The prospecting, approved and proposed developments within a 50km radius will be taken into consideration as they have the potential to create supplementary positive or negative socio-economic impacts identified in this study or vice versa. The **projects considered for the cumulative assessment** include:

- The 75MW AEP Legoko PV Solar Facility
- The 75MW AEP Mogobe Photovoltaic Solar Facility
- Kathu Solar Energy Facility
- Kathu Solar Energy Facility 25MW 2
- Sishen Solar Farm
- Solar farm for Bestwood
- Kalahari Solar Power Project
- A 19MW PV Solar Power Generation Plant
- 150mw Adams PV Solar Energy Facility
- Roma Energy Mount Roper Solar Plant
- Keren Energy Whitebank Solar Plant
- San Solar Energy Facility and associated infrastructure
- Renewable energy generation project – Shirley Solar Park
- 75MW Perth-Kuruman Solar Farm
- 75MW Perth-Hotazel Solar Farm and associated infrastructure
- 75MW AEP Kathu Solar PV Energy Facility
- Kagiso Solar Power Plant near
- 115MW Boitshoko Solar Power Plant
- Tshepo Solar Power Plant

5.5 Sources of Information

The project made use of both primary and secondary data in order to assess the impacts and desirability of the project.

Indirect data analysed was mainly derived from the following sources and programmes:

- Stats SA Census, 2011
- Quantec Research Standardised Regional Data, 1995-2017
- John Taolo Gaetsewe District Municipality Integrated Development Plan 2012-2017
- John Taolo Gaetsewe District Municipality Spatial Development Framework 2017
- Ga-Segonyana Local Munic pality Integrated Development Plan 2015/16 Review
- National Development Plan (NDP) 2030
- Mapable 2018
- Project data and maps obtained from client
- EIA and scoping documents for surrounding projects

The primary data gathering for this project was done via telephonic interviews and email questionnaires as these means were indicated to be preferred methods of communication by the key respondents. The interviews took place from the 08th to the 09th of March 2018 and included interviews with the following directly affected land owners:

- Clive Albutt, the owner of the following potentially directly affected farm portions:
- Portion 2 and 4 of Farm Carrington 440
- Portion 1 and 2 of Farm Hartland 381
- Remainder of Farm Woodstock 441
- Remainder of Farm Rossdale 382
- Sarel Du Plessis, the owner of the following potentially directly affected farm portions:
- Portion 1 of Farm Bramcot 446

2 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

A policy review plays an integral role in the early stages of a project. The review provides a high-level indication of whether a project is aligned with the goals and aspirations of the developmental policy within a country through to the local level. Furthermore, the analysis indicates any red-flag or developmental concerns that could jeopardise the development of the project. This assists in amending and preventing costly and unnecessary delays. Table 1 below outlines the objectives and main relevant ideas stipulated per policy, as well as the alignment of the proposed project with these.

Table 1: Project alignment with policy objectives

Policy	Key Policy Objectives	Source
National Policy: South Africa		
National Development Plan 2030	✓ Creating jobs and livelihoods ✓ Expanding infrastructure ✓ Transitioning to a low-carbon economy ✓ Transforming urban and rural spaces • Improving education and training • Providing quality health care • Building a capable state • Transforming society and uniting the nation • Fighting corruption and enhancing	(NPC, 2011)

Policy	Key Policy Objectives	Source
	accountability	
New Growth Path Framework 2011	✓ Infrastructure investment • Main economic sectors as employment sectors ✓ Seizing the potential of new economies ✓ Investing in social capital and public services ✓ Fostering rural development and regional integration	(Department of Economic Development, 2011)
Renewable Energy Vision 2030 South Africa	✓ Renewable energy as an exceptional source of flexible supply within the context of uncertain energy demand ✓ Comprehensive renewable energy base will support a resilient South African future ✓ A sustainable energy mix that excludes undue risks for the environment of society	(World Wildlife Fund, 2014)
Integrated Energy Plan 2016	✓ South Africa should continue to track a diversified energy mix which lessens reliance on a few primary energy sources ✓ In addition to solar energy facilities, wind energy should continue to contribute in the generation of electricity • Allocations to safeguard the development of wind energy projects aligned with the Integrated Resource Plan 2010 should continue to be pursued ✓ Ensure energy security and supply ✓ Reduce environmental impacts • Endorse job creation and localisation ✓ Lessen cost of energy • Reduce water consumption ✓ Diversify supply sources • Promote energy efficiency • Promote energy access	(Department of Energy, 2016)
The Constitution of South Africa 1996	✓ "Everyone has the right to an environment that is not harmful to their health or well-being" (S24) • The environment should be protected for the benefit of present and future generations, through reasonable legislative and other measures that: ✓ Prevent pollution and ecological degradation ✓ Promote conservation ✓ Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development	(Republic of South Africa, 1996)
White Paper on Energy Policy of the Republic of	✓ Seeks to ensure that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy	(Department of Minerals and Energy, 1998)

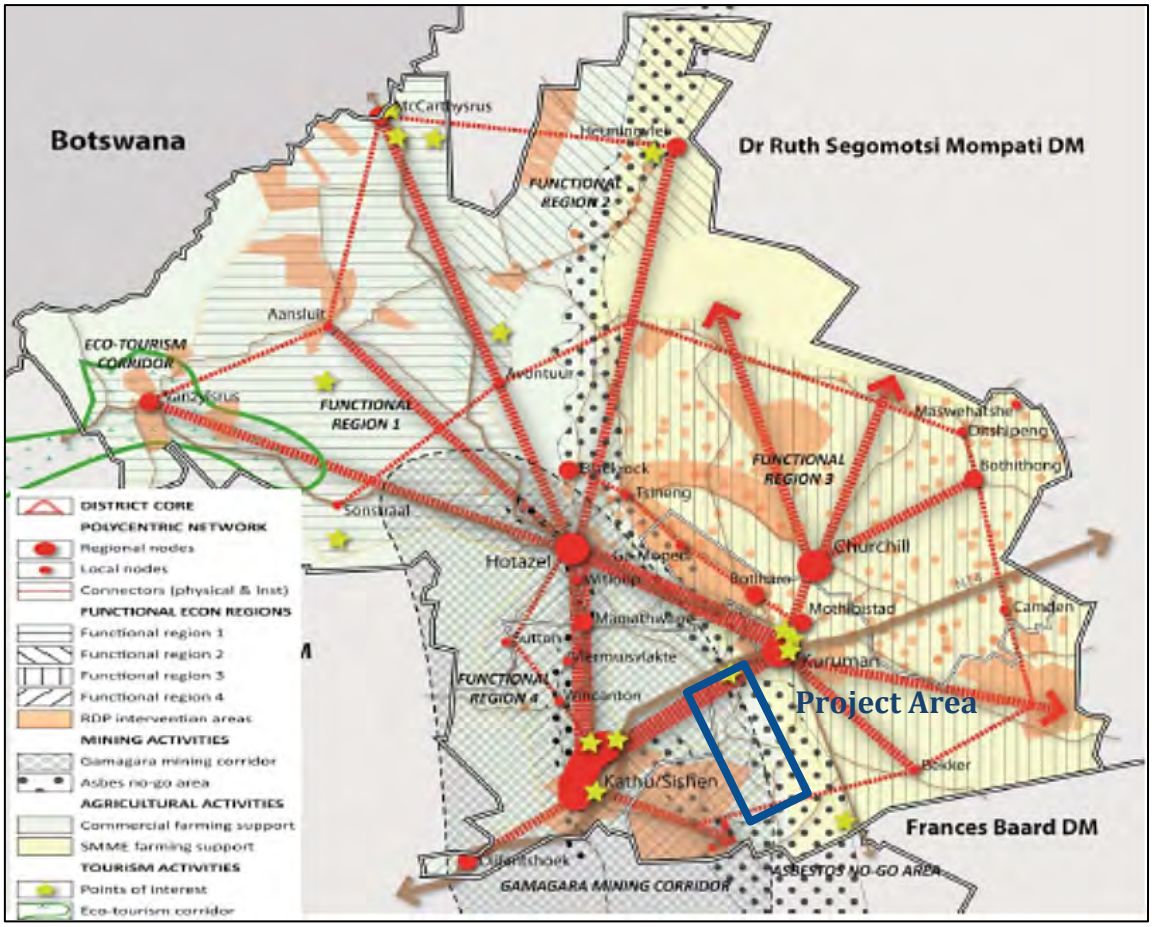
Policy	Key Policy Objectives	Source
South Africa 1998	supply options ✓ Aims to create energy security by diversifying the energy supply and energy carriers	
White Paper on the Renewable Energy Policy of RSA 2003	✓ Pledges government support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications	(Department of Minerals and Energy, 2003)
Provincial Policy: Northern Cape		
Northern Cape Provincial Development and Resource Management Plan 2012	✓ Seeks to create a prosperous, sustainable and expanding provincial economy to eradicate poverty and improve social development • Aims to create a continuous network of natural resource areas throughout the province that maintain ecological processes and provide ecosystem services ✓ Aims to endorse and institute innovative energy technologies to improve access to reliable, sustainable and affordable energy services with the objective to realise sustainable economic growth and development	(Office of the Premier of the Northern Cape, 2012)
Municipal Policy: John Taolo Gaetsewe District Municipality		
John Taolo Gaetsewe District Municipality Integrated Development Plan 2016	Strategic objectives for the municipality are: • Water and sanitation • Roads and transport ✓ Local Economic Development ✓ Land development and reform • Integrated human settlements ✓ Sustainable development-oriented municipality • Promotion of health • Disaster management ✓ Environmental management, conservation and climate change management	(John Taolo Gaetsewe District Municipality, 2016)
Local Municipality: Ga-Segonyana Local Municipality		
Ga-Segonyana Loca Municipality Integrated Development Plan 2015/16 Review	✓ An integrated municipality that is committed to the creation of a better life through sustainable development for the people of Ga-Segonyana • Aims to provide democratic and accountable government for local communities ✓ Aims to ensure the provision of services to communities in a sustainable manner ✓ Aims to promote social and economic development • Aims to promote a safe and healthy environment • Aims to encourage the involvement of communities and community organisations in the matters of local government • Aims to structure and manage its administration, budgeting and planning processes to give priority to the basic needs of	(Ga-Segonyana Local Municpality, 2015)

Policy	Key Policy Objectives	Source
	the community and to promote the social and economic development of the community ✓ Aims to participate in national and provincial development programmes • Aims to create an enabling environment for economic growth and to reduce unemployment and alleviate poverty	
Ga-Segonyana Service Delivery and Budget Implementation Plan 2017	✓ Progressive sustainable development • Skills development ✓ Aims to develop and maintain infrastructure and community services • Aims to enhance revenue and financial management	(Ga-Segonyana Local Municipality, 2017)

A correlation between the proposed windfarm and the goals of strategic documents is evident. National policy echoes renewable energy sentiments dating from pre-2000. Provincial policy seeks to create an enabling environment for economic growth and environmental preservation. Lastly, local policy places emphasis on service delivery improvement and enhancing the socio-economic conditions for residents.

From a spatial perspective, the following should be noted:

- Historically, asbestos has been mined, mainly in a strip to the east and parallel to the Gamagara corridor. These mines have been decommissioned due to the prevalence of a hazardous substance in asbestos (John Taolo Gaetsewe DM, 2017). An area in circumference to these mines has been identified by the John Taolo Gaetsewe District Municipality in its spatial Development Framework of 2017, where development is prohibited. This is therefore a potential red flag as the proposed project site is within this prohibited zone as outlined in the map below. However, due to the distress resulting from mine closures, job creation in this region is imperative. A guideline for any project planned to be developed in the no-go area includes a screening process which is specifically designated to identify high risk areas. Furthermore, a recommendation to allow minimal land use activities on rehabilitated areas is permitted but excludes the extensive development of these areas. The need for rehabilitation of asbestos pollution through the quantification of risks associated with a specific pollution site is a pre-requisite for development in any asbestos polluted areas (John Taolo Gaetsewe DM, 2017).



Map 0-1: John Taolo Gaetsewe DM Spatial Development Framework (John Taolo Gaetsewe DM, 2017)

- At a local municipality level, the Ga-Segonyana LM SDF seeks to develop a regional node comprising of social facilities, a diversified housing provision, a minimum of one shopping centre and light industry (Ga-Segonyana Local Municpality, 2015). Moreover, the SDF aims to retain and strengthen the game farming and tourism-based economies, which is relevant for some of the directly affected farm portions.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

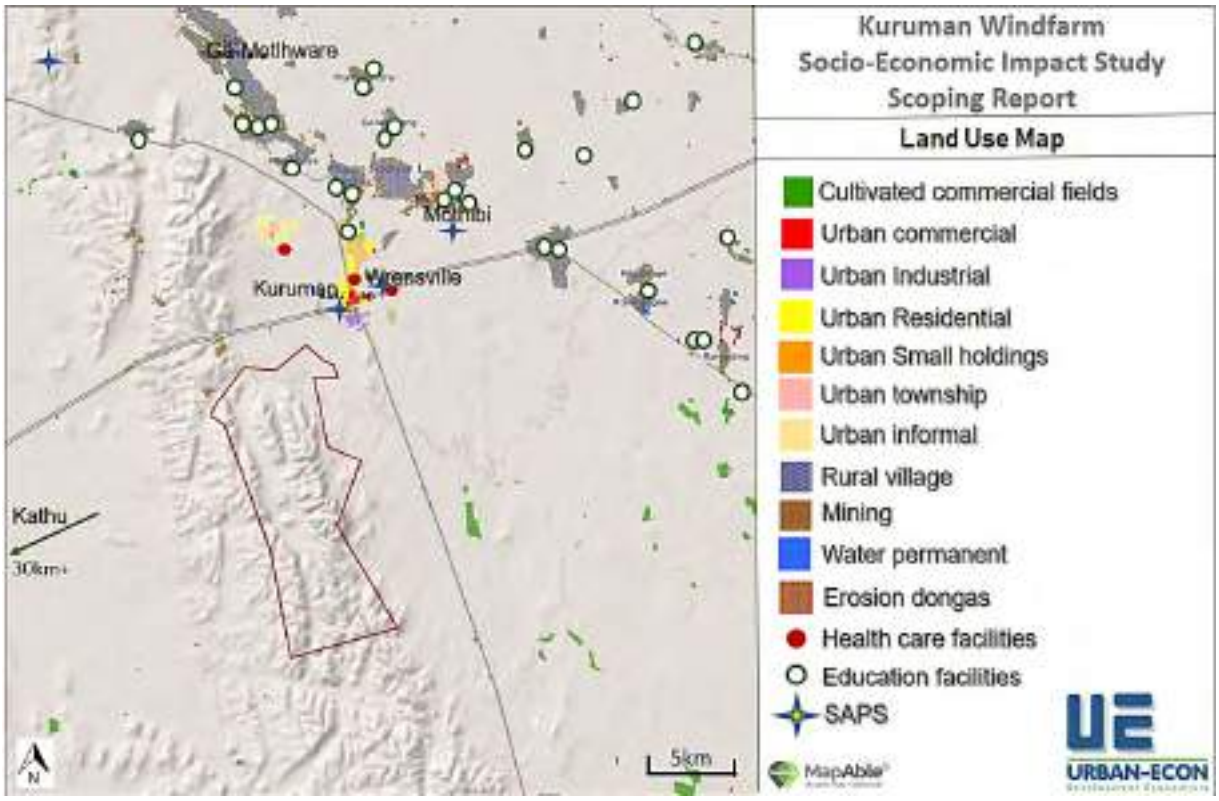
5.6 Baseline Description of the Receiving Environment

3.1.1 Land Use Profile in Surrounding Area

The site-related information section will investigate the various dynamics of the proposed project location. Map 2 below serves to demonstrate the land uses on the proposed project site and the surrounding area. In addition, the map serves to illustrate the terrain and the locations of social facilities. The deductions made are firstly that limited activity is taking place from a regional perspective. Furthermore, activities are concentrated to the north-east of the proposed project site, wherein the town of Kuruman and the villages Mothibi and Ga-Motlhware are located. Kuruman is less than 5km away from the proposed project site, and the closest residential communities of Bodulong and Wrensville are 8km and 9km away, respectively. Economic activity, including commercial and retail, is featured in the residential and business district. The north-west section of the project site hosts pockets of mining activity.

With regard to social facilities, there are numerous primary, secondary and intermediate schools serving the communities located to the north-east of the project site. Furthermore, one private

hospital is located near Kathu, over 30km south-west from the project site. Additional health facilities such as clinics and public hospitals are concentrated in Kuruman. Lastly, three police stations are within 15km from the proposed project site.



Map 0-2: Land Use Map of Proposed Kuruman Windfarm Site and surrounding areas (Geo-terraimage, 2014)

The geo-fabric terrain demonstrates the mountainous and steep characteristic of the proposed project site. In terms of accessibility, the project site is accessible from the N14 which connects to Springbok to the south-west and Pretoria to the north-east.

3.1.2 Land Use Profile of Proposed Project Site

The proposed project will affect the following six farm portions in Phase 1:

- Portion 2 and 4 of Farm Carrington 440
- Portion 1 and 2 of Farm Hartland 381
- Remainder of Farm Woodstock 441
- Remainder of Farm Rossdale 382

The proposed project will affect the following two farm portions in Phase 2:

- Portion 1 of Farm Bramcote 446
- Remainder of Farm Bramcote 446

From the interviews with the directly impacted land owners, the land activities and the area dedicated to each are:

- Commercial farming:
    - Livestock farming 22 500 ha
    - Game hunting and viewing 7 600 ha
    - Game breeding 7 700 ha
    - Dry land crop production 2 ha
    - Irrigation crop production 2 ha

- Game range
- Wedding venue and conference centre
- Tourist lodge

There are about 19 adjacent farm portions whose views will be probed and presented in the next (EIA) phase.

3.1.3 Economic Activities on Proposed Project Site

The economic activities hosted on the envisaged project area are agriculture and tourism related.

- **Mr Albutt** owns and utilises all the farm portions sought for Phase 1 of the Kuruman Windfarm. Mr Albutt derives his main source of income from game hunting and the accommodation offering lodge. With regard to visitation for game hunting, he receives about 20 international and 50 domestic visitors who each stay for an average of five days. The game hunting is not limited to specific seasons and is constant throughout the year.

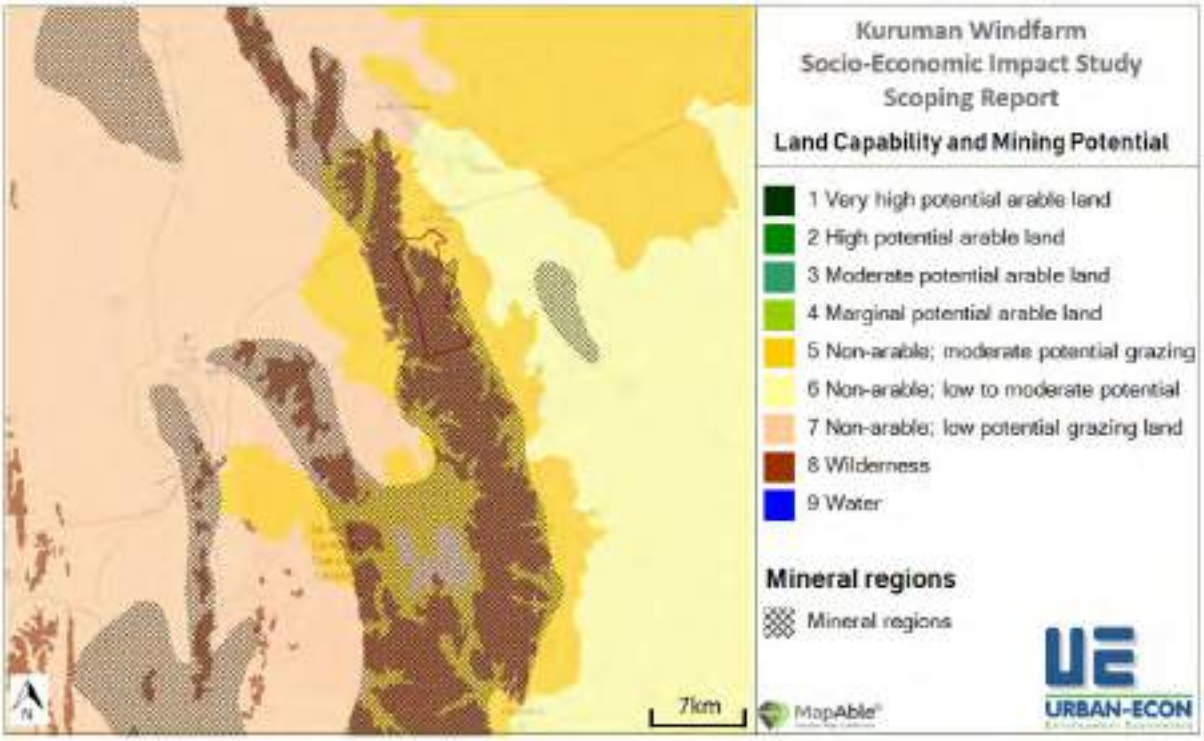
  The additional economic activity observed on the potentially directly affected farm portions is the lodge, which caters for accommodation purposes and is active throughout the year. In addition, provision for weddings and events and conferences is made. On a minimal scale, there is dry land and irrigated crop production; a shared 4 ha is dedicated to this. The total staff permanently employed on these farm portions are 15, none of which reside on the premises. They currently earn R150 per day. Four family members permanently reside on the premises.

- **Mr Du Plessis** owns the farm portions envisioned for Phase 2 of the Kuruman Windfarm development. The economic activity taking place herein is livestock farming. This takes place on 22 000 ha of land, and the livestock is cattle. There are no additional economic activities taking place on this land. Three of the family members reside on the premises.

3.1.4 Perspective of landowners on proposed project

According to both land owners interviewed, the proposed projects will not prohibit nor disturb the current economic activities observed on their land portions. No concerns have been raised by either of the directly affected land owners. Additionally, no loss in employment is expected. Mr Albutt considers his farm portions to be scenic but does not foresee the wind turbines detracting from the natural aesthetic. He perceives the proposed project as one that is symbolic of a less polluted future. The Kuruman Windfarm is essentially noted as a positive project.

3.1.5 Land potential and capability



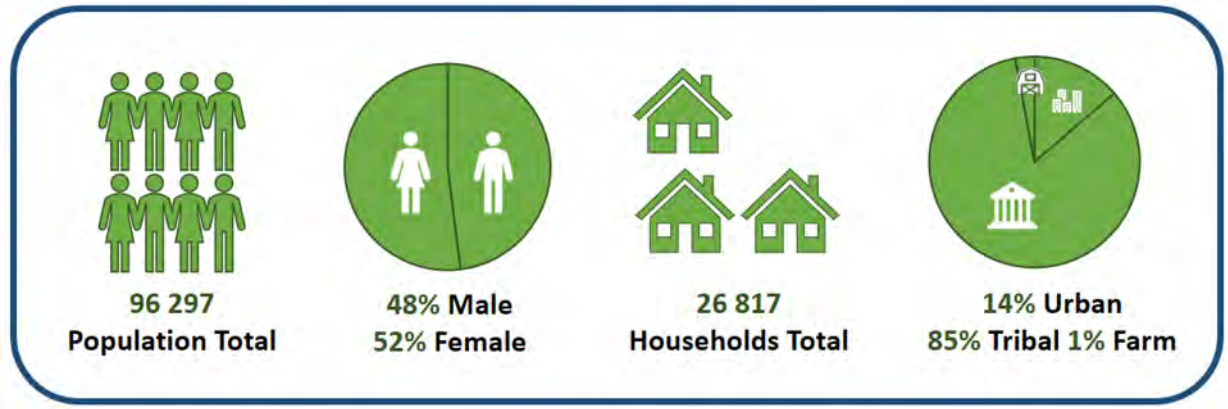
Map 0-3: Land Capability and Mining Potential in Zone of Influence (Council of Geo-Sciences)

Map 3 above demonstrates that the project site is located in a region with non-arable land, with moderate to low potential grazing land. The proposed project site specifically is characteristic of wilderness and on a minute scale, non-arable land with moderate grazing potential. In addition, it is located within a mineral region.

In a quest to further understand the zone of influence, the larger regional dynamics ought to be understood. The following section serves to provide the socio-economic profile of the larger region in which this site is affected and affects.

3.2 Population Demographics

The Ga-Segonyana Local Municipality (LM) has a population of approximately 96 297, with a total of 93 651 households (Stats SA, 2017). This is indicative of an average household size of 3.5 in the municipality. The Ga-Segonyana LM constitutes 8% of the provincial population and two-fifths of the John Taolo Gaetsewe District Municipality (DM) population, making it the largest in the district. Furthermore, 44% of the total households in the Taolo Gaetsewe DM are located in the Ga-Segonyana LM. The average population growth rate over the past five years has been just over 1%, indicative of stagnant to slow population growth. This could be attributed to the closure of mines and limited job opportunities thus resulting in limited in-migration of job seekers and migrant labour. The closest town, Kuruman had 3 188 households with 13 057 residents in 2011 (Quantec Easy Data, 2017).



A large portion of 85% of the population reside in tribal areas, followed by 14% located in urban areas, and the remaining 1% reside on farm land (Stats SA, 2017) . In the zone of influence, the population density is concentrated in Kuruman town and Mothibi village. The majority of the residents in the Ga-Segonyana LM (87%) are Black, 8% are Coloured and 4% are White. Setswana is the most commonly used language in the municipality followed by Afrikaans (Stats SA, 2017).

Across all scales, a greater proportion of the population is comprised of females. Figure 0-3 below further indicates that the majority of the population are aged between 15 and 34, and the minority of the population are aged over 65 years (Quantec Easy Data, 2017). This is similar at a provincial and national scale. The working age population (15-64) constitutes just over 63% of the population. Close to a third of the population are aged below the age of 15. Figure 0-3 below further supports the fact that the population in the Ga-Segonyana LM is growing at a slow rate.

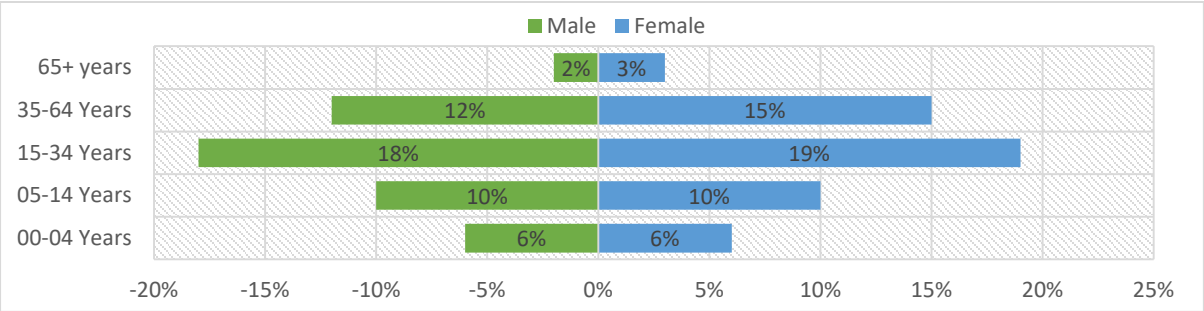
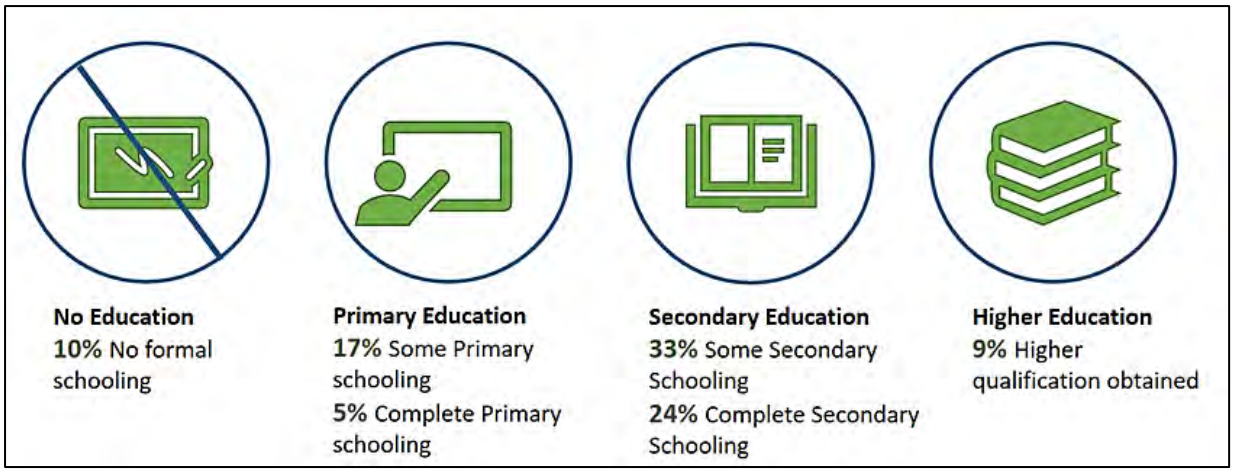


Figure 2: Population pyramid for the Ga-Segonyana Local Municipality

3.3 Education and Skills



In the John Taolo Gaetsewe DM, Ga-Segonyana LM and the towns of Kuruman, the adult population with no schooling constitutes 14%, 9% and 5%, respectively (Quantec, 2017). Kuruman has the highest population of residents who have completed matric and have higher qualifications. Just over a third of the adult population have attained a matric certificate (Stats SA, 2017). The education levels are therefore moderate but have great room for improvement.

3.4 Income Levels

Overall, 45% of the households within the local municipality earned up to R3 200 per month. In Kuruman, 7% of the households had no income and 29% earned up to R3 200 (Stats SA, 2017). The largest range of income earned in the Northern Cape is between R1 and R3 200. The household income in area signals the stringent manner in which residents meet their needs and the dependence on government. In contrast, a minority of the population can be classified as middle-income earners and high-income earners, who thus have relatively increased purchasing power, which implies a comfortable livelihood.

Figure 3: Monthly Income levels on Provincial, District and Local Scale

Income Level	Northern Cape	Ga-Segonyana LM	Kuruman
No income	7,6%	8,1%	7,3%
R1-R3200	53,5%	44,6%	28,5%
R3201-R6400	14,1%	18,2%	18,2%
R6401-R12800	13,3%	17,2%	20,1%
R12801-R25600	8,2%	8,7%	16,6%
R25601-R51200	2,3%	2,3%	7,0%
R51201-R102400	0,5%	0,5%	1,5%
R102401-R204800	0,3%	0,2%	0,5%
R204801 +	0,2%	0,1%	0,3%

(Urban-Econ calculations based on Quantec data, 2018)

3.5 The Economy

In 2016, The Ga-Segonyana LM economy was valued at R7 101 million in constant prices. The LM contributes a quarter to the economy of the John Taolo District Municipality and 6% to the economy of the Northern Cape (Quantec, 2017). Over a period of six years (2010-2016), the municipality's economy grew at a positive compounded annual growth rate (CAGR) of 3% per year. This is similar to the district and provincial growth of 2% and 3%, respectively.

Figure 4: Northern Cape and Ga-Segonyana LM structure of economies

Economic Sector	Northern Cape (GDP in 2010 prices)			Ga-Segonyana LM (GDP in 2010 prices)		
	GDP (R'mil)	% of GDP	CAGR (2010-2016)	GDP (R'mil)	% of GDP	CAGR (2010-2016)
Agriculture, forestry and fishing	R10 908	9%	0%	R371	5%	3%
Mining and quarrying	R30 141	25%	2%	R1 880	26%	3%
Manufacturing	R7 479	6%	0%	R500	7%	1%
Electricity, gas and water	R3 973	3%	2%	R215	3%	1%
Construction	R5 260	4%	2%	R390	5%	3%
Trade	R12 892	11%	2%	R905	13%	3%
Transport and communication	R12 688	11%	3%	R730	10%	5%
Finance and business services	R16 760	14%	3%	R988	14%	5%
General government	R14 369	12%	2%	R726	10%	1%

Economic Sector	Northern Cape (GDP in 2010 prices)			Ga-Segonyana LM (GDP in 2010 prices)		
	GDP (R'mil)	% of GDP	CAGR (2010-2016)	GDP (R'mil)	% of GDP	CAGR (2010-2016)
Personal services	R6 003	5%	3%	R397	6%	3%
TOTAL	R120 473	100%	2%	R7 101	100%	3%

Urban-Econ calculations based on Quantec data

The economic sector with the greatest contribution to the GDP-R of the Northern Cape is mining and quarrying. Similarly, mining is the highest contributing economic sector in the Ga-Segonyana LM (Quantec, 2017). This indicates the vulnerability of the municipal economy in the case of a crisis in the mining sector. Electricity, gas and water is the economic sector with the least contribution to the GDP-R of the municipality (Quantec, 2017). Between 2008 and 2010, most economic sectors experienced a decrease in GDP-R as a result of the economic crisis. However, construction, trade, finance and business services and general government did not have a decline in GDP-R during that period.

3.6 Labour Force Composition

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs and improve their standard of living. As such, employment and unemployment rates are important indicators of socio-economic well-being. The following paragraphs examine the study area's labour market from a number of perspectives, including the employment rate and sectoral employment patterns.

According to Census 2011 data, the working age population of Ga-Segonyana LM was about 59 226. Amongst these, 48 147 were economically active. Not economically active (NEA) persons are those who were neither employed nor unemployed, including discouraged job seekers. The Municipality had 29 741 NEA persons in 2011. The employed labour in the municipality was estimated at 18 945, whilst the unemployed labour was about 10 257. This results in an unemployment rate of 35%, which is much higher than the national unemployment rate.

Figure 5: Labour Profile in John Taolo Gaetsewe DM and Ga-Segonyana LM

Indicators	John Taolo Gaetsewe DM	Ga-Segonyana LM
Total	237 529	94 498
Working age	144 710	58 943
Formal and informal - Total	49 031	18 945
Employed - Formal	38 130	14 048
Employed - Informal	10 901	4 897
Unemployed	18 765	10 257
Not economically active	76 914	29 741
Unemployment rate	28%	35%
Labour force participation rate	47%	50%

(Stats SA, 2017)

3.7 Employment Structure

Close to three-quarters of the employed individuals in the Ga-Segonyana LM were employed in the formal sector and just over a quarter were employed in the informal sector (Quantec Easy Data, 2017). In both the John Taolo DM and the Ga-Segonyana LM, the wholesale and retail trade, catering and accommodation economic sector employs the largest number of people, whereas the electricity, gas and water economic sector has the lowest number of employed people. The secondary sector has been the sole sector with gradual growth of employment figures in the past five years. On the contrary,

the sector that generates the largest GDP for the LM – mining – has experienced a minute decline in employment for three consecutive years from 2013 to 2015 (Quantec Easy Data, 2017).

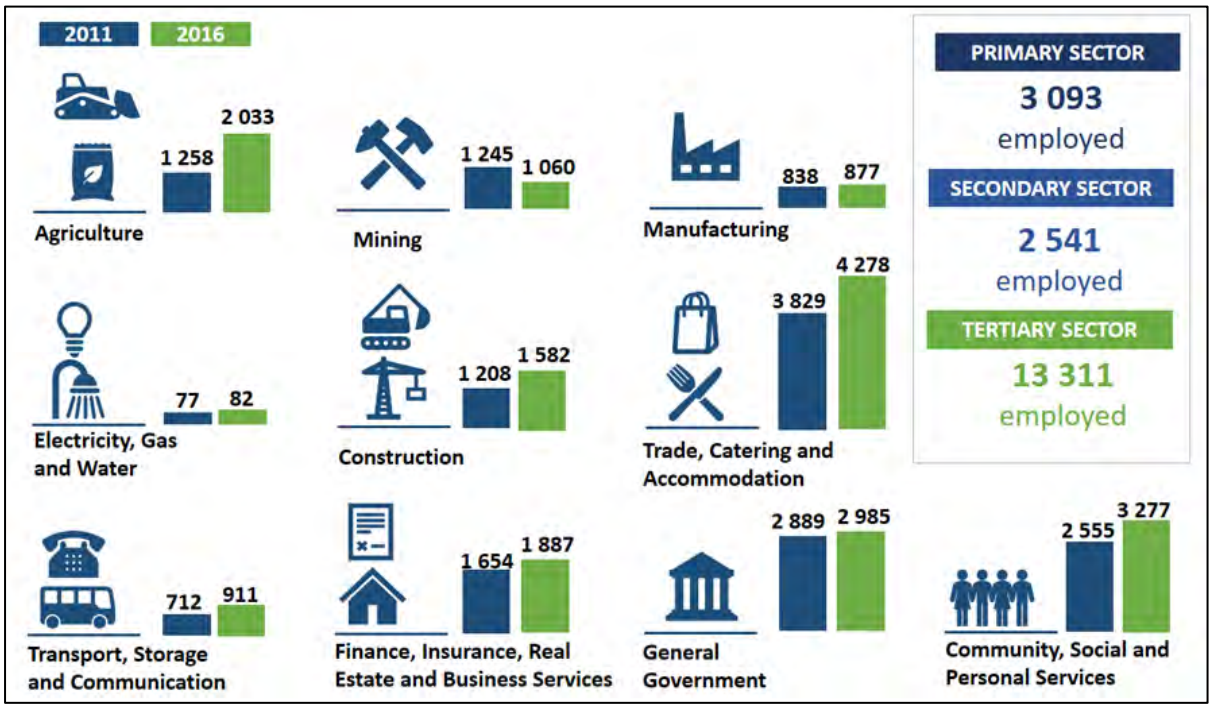


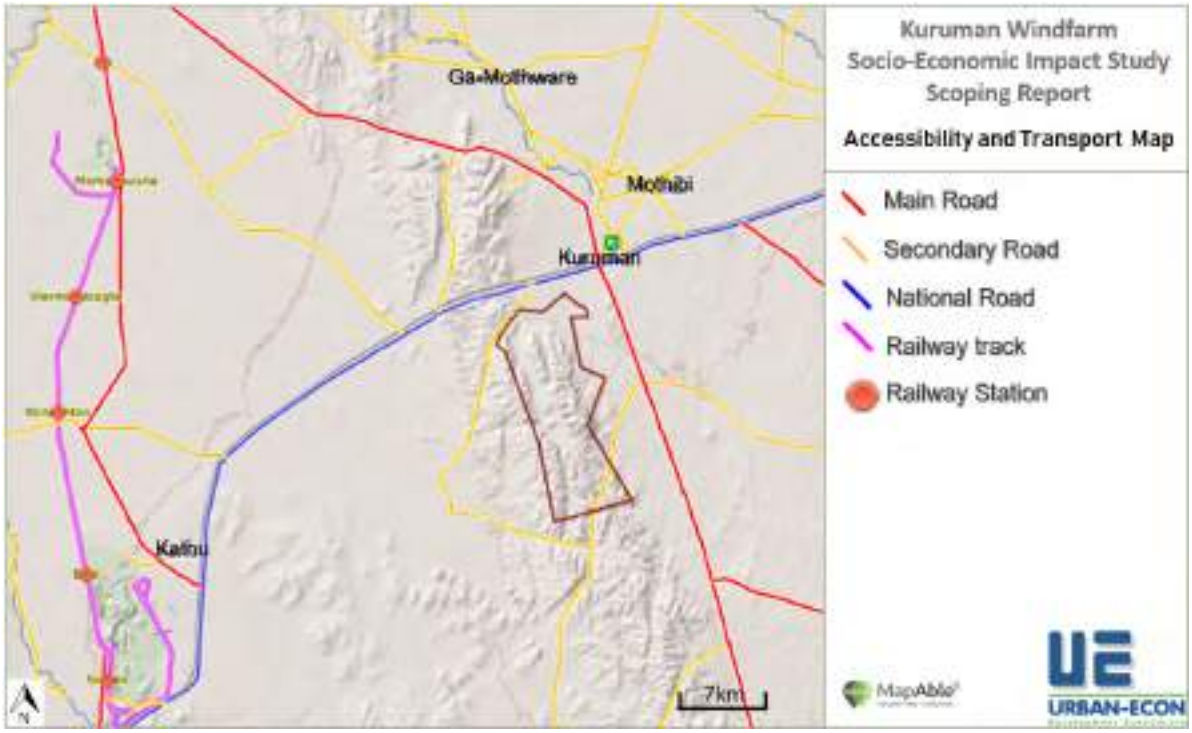
Figure 6: Employment figures comparison between 2011 and 2016 per economic sector (Urban-Econ infographics based on Quantec data, 2017).

3.8 Services and Infrastructure

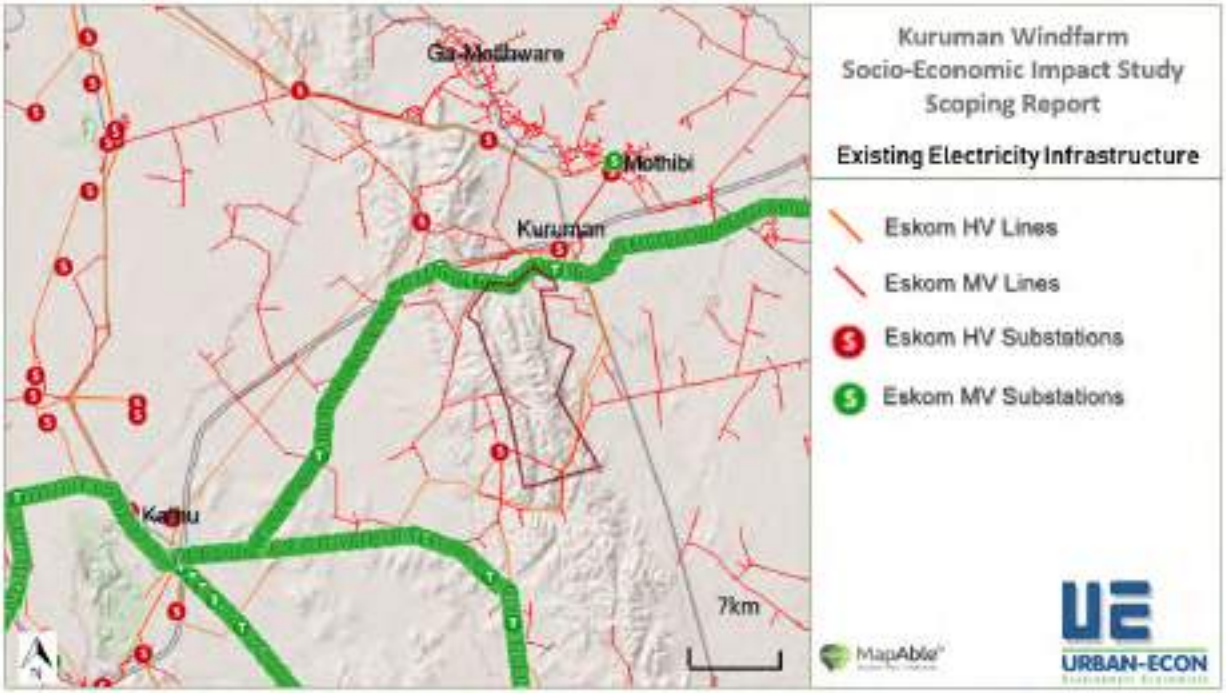
Figure 7: Status of service delivery in Ga-Segonyana LM (Ga-Segonyana Local Municpality, 2015)

The Ga-Segonyana LM has backlogs in all basic services, with refuse removal having the largest backlog of 37%. Nonetheless, the overall service delivery is moderate.

According to the IDP, main roads are in good condition, however gravel roads serving as access routes to the rural areas are in poor condition. The roads, electricity infrastructure and water infrastructure are poorly managed. Moreover, illegal electricity connections have been rife. Furthermore, there are areas such as Gantantelang that have no electricity connection for over 17 years. New electricity connections are planned as well as maintenance and upgrading (Ga-Segonyana Local Municpality, 2015).



Map 0-4: Accessibility and Transport of larger Kuruman region (Mapable, 2018)

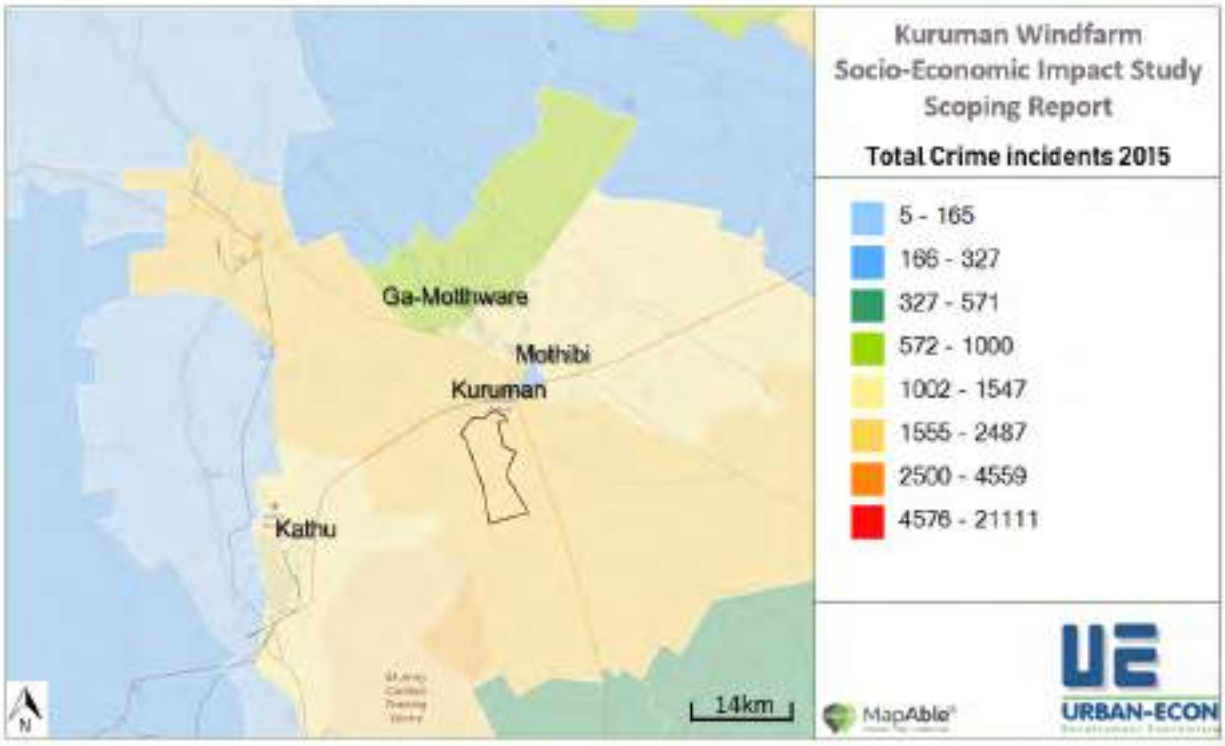


Map 0-5: Existing Electricity Infrastructure in broader Kuruman region (Mapable, 2018)

3.9 Crime Statistics in study area

Map 6 below demonstrates the total number of total crime incidents reported per police precinct in 2015. As mentioned, there are thee (3) police stations within 15km from the proposed project site. Evidently, the precinct where the proposed project site is located had had 1 002 to 1 547 reported crime incidents in 2015. The most pertinent crimes in the precinct, in which the proposed project is located, were (Institute for Security Studies, 2015):

- Theft out of motor vehicle (307 – 441 incidents)
- Burglary at business premises (136 – 587 incidents)
- Stock theft (49 – 240 incidents)



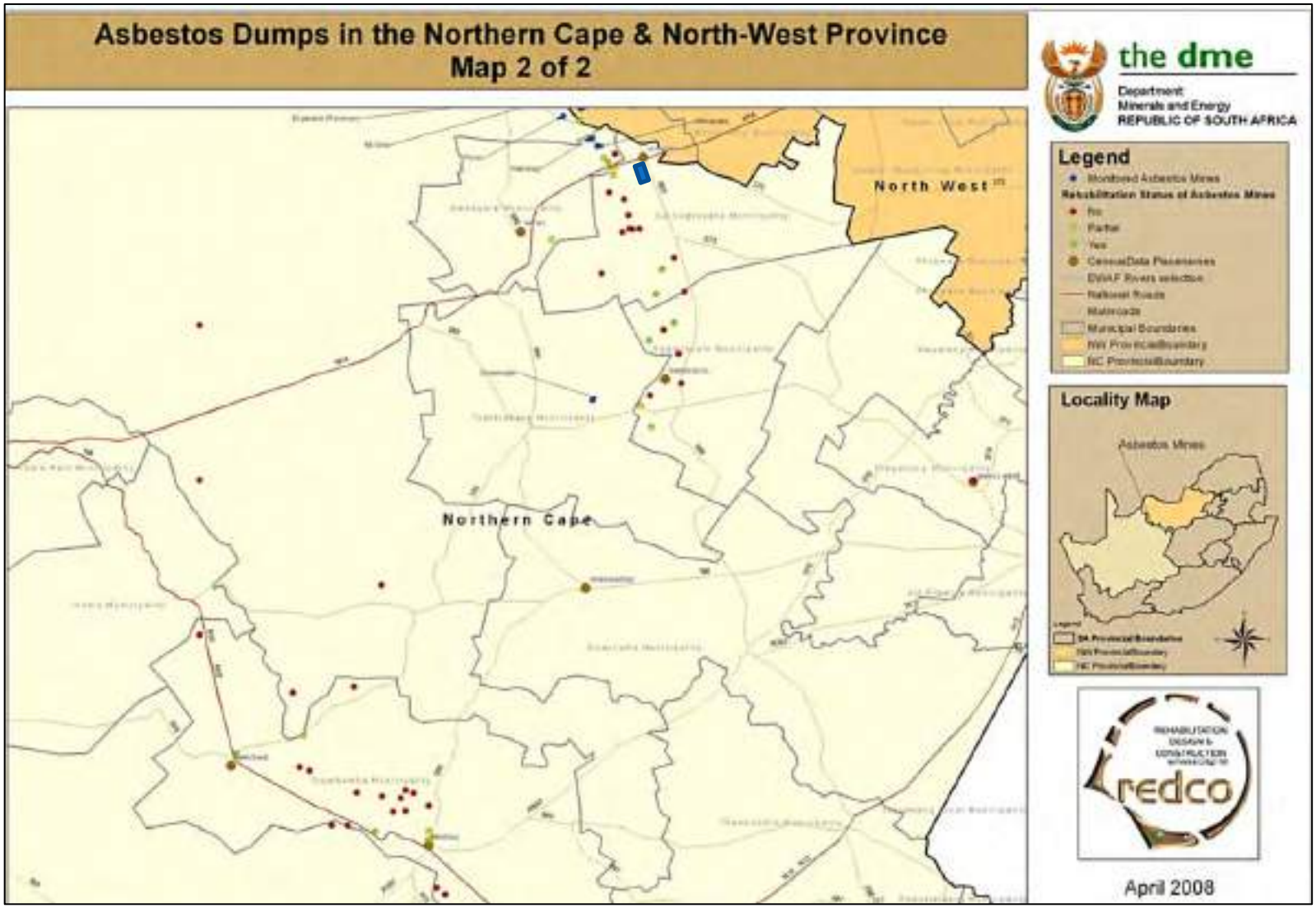
Map 0-6: A spatial representation of the Total Crime incidents reported in 2015 (Institute for Security Studies, 2015)

3.10 Environmental Sensitivity Map

The quantification of the risk associated with a specific pollution site is a prerequisite for development in any asbestos polluted region (John Taolo Gaetsewe DM, 2017). This is the identified sensitive area and is indicated in Map 0-7 below. From the map it is evident that:

- There is no asbestos mine located on the envisaged project area
- The proposed project is located in close proximity to seven un-rehabilitated asbestos mines
- The proposed project is located near three partially rehabilitated asbestos mines
- The proposed project is situated near three rehabilitated asbestos mines (Liebenberg-Weyers, 2010)

However, the poor state of rehabilitation of the asbestos industry continues to render previously contaminated areas a serious constraint for development due to the remaining associated health risks (John Taolo Gaetsewe DM, 2017). Un-rehabilitated dumps continue to have the potential to pollute the environment and cause fatal diseases such as mesothelioma.



Map 0-7: Asbestos dumps in the Northern Cape (Liebenberg-Weyers, 2010)

4 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE SOCIO-ECONOMIC ASSESSMENT

The socio-economic impacts are triggered by aspects emanating from the proposed project. These include the following:

- Site clearance - removal of vegetation and top soil as part of site preparation for construction of roads and wind turbine assembling and installation.
- Heavy machinery movement- the construction activities will include the movement of vehicles and machinery.
- Wind turbines assembly and installation
- Road construction
- Construction of temporary and permanent supporting facilities
- Capital expenditure and operating expenditure
- Influx of migrant labour and job seekers
- Local rates, payroll taxes and income

5 IDENTIFICATION OF IMPACTS

5.6.1 Identification of Potential Impacts

The culmination of all data gathered and analysed, as well as the past experience with similar projects, assisted in the identification of the following impacts that are to be assessed during the EIA phase.

5.6.1.1 Construction Phase

- Increase in production and GDP-R due to capital expenditure
- Temporary employment creation due to construction activities
- Skills development and enhancement due to construction activities
- Household income attainment due to employment opportunities
- Increased demand for housing and social facilities due to influx of migrant labour and job seekers
- Potential increase in theft related crimes due to high unemployment rate, social ills, and increased movement of people in area
- Change in sense of place due to construction activities

5.6.1.2 Operational Phase

- Increase in production and GDP-R due to operating expenditure
- Long-term employment creation due to operation and maintenance activities
- Skills development and enhancement due to operation activities
- Household income attainment due to employment opportunities
- Increase in local government revenue due to rates and taxes
- Change in sense of place due to visual impact of wind turbines

5.6.1.3 Decommissioning Phase

- Local economy stimulation due to decommissioning costs
- Temporary employment creation as a result of decommissioning activities
- Change in sense of place due to removal of wind turbines

5.6.1.4 Cumulative impacts

- Potential increase in crime
- Change in sense of place
- Demographic changes due to influx of job seekers
- Contribution towards energy security

6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

This chapter presents the analysis of the identified potential socio-economic impacts that are expected to ensue as a result of the development of the proposed Kuruman Windfarm. An evaluation of these impacts according to the predefined criteria will be done.

6.1 Increase in Production and GDP-R due to Capital Expenditure and Operations Expenditure

The economic impact arising from the initial investment will be felt throughout the economy with windfall effects benefitting related sectors in the economy. The effect is allocated according to direct, indirect and induced impacts, together forming the "multiplier effect". These various impacts or spill-over effects spread throughout the economy, contributing to heightened production levels. The initial investment will give rise to a production effect where manufacturers and suppliers of goods and services would experience the need to expand current production levels by ramping up employee numbers and operations. Down-the-line effects will produce a consumption-induced effect on the wider economy - as total salaries paid-out rises, consumer expenditure will lift, thereby raising the sales of goods and services in the surrounding economy.

The economy of Ga-Segonyana has been growing at an average of 3% per year and is highly dependent on the mining sector. The proposed project will slightly diversify the economy and strengthen the relatively minute energy sector.

Gaps in knowledge:

- Capital expenditure to be invested in project
- Duration of construction phase
- Operations expenditure and breakdown
- Duration of operations phase

6.2 Temporary and Long Term Employment Creation

Construction phase activities, operations and maintenance will require human resources. Thus, the creation of employment will ensue. This impact is positive as it will contribute to the slight decrease to the 35% unemployment rate in the Ga-Segonyana LM, albeit temporary during the construction phase. It is highly likely that employment will be created and to enhance this impact a training programme is recommended so as to develop the local skill levels that are largely semi-skilled. This will enable employability in the local area and additionally decrease the unemployment rate as mentioned. With this enhancement measure applied, the significance of job creation will be very high.

Gaps in knowledge**:**

- The number of employment opportunities to be created during construction
- The number of employment opportunities to be created during operations
- Where labour will be sourced (percentage local versus percentage regional or national)

6.2.1 Skills Development and Enhancement

A variation of skill sets is required ranging from semi-skilled construction workers to highly skilled engineers. The municipality has close to a fifth of skilled residents and a majority of semi-skilled residents. The required set of skills will not be fully attainable from the local area; thus, it is highly likely that migrant labour will be employed. All those employed will either develop new skills or enhance current skills. This insinuates that inexperienced workers will have the opportunity to attain and develop new skills, whilst experienced workers will further enhance their current skills. The reversibility of skills is low and the irreplaceability is high. In the case wherein skills development programmes and training take place, the significance of skills development will be very high, whereas without skills development will be high.

Gaps in knowledge:

- Training opportunities or skills development programmes be made available to the local community by the developer

6.2.2 Change in sense of place

The current sense of place is rural, with dominant primary activities. It is tranquil with a tourism offering. Construction activities are inclusive of soil clearance, assembling and installation amongst others. In addition, vehicular movement and a greater prevalence of people than usual will be present. As a result, the sense of tranquillity will be temporarily disturbed, resulting in a change in the sense of place. Furthermore, noise will be generated, and the visual aesthetic will be altered. Quintessentially, there will be a change in the general sense of place during construction.

During operations, 99 wind turbines will be erected and will certainly change the current visuals. Thus, a change from rural to industrial is expected. Therefore, a change in sense of place during operations is expected.

Gaps in knowledge:

- Visual sensitivity map

6.2.3 Increase in Household Income due to employment opportunities

Household earnings are linked closely with trends in employment and, as such, will be affected positively by the increase. The creation of employment during the construction period will increase affected households. Resultantly, an improvement in the standard of living based on the additional monthly income will accrue. A portion of this income will be earned by households residing in the local communities, thus positively impacting the local economy. This will improve the current income profile of the Ga-Segonyana LM, which is dominated by low-income earners.

Gaps in knowledge:

- Where labour will be sourced (percentage local versus percentage regional or national)
- Expected salaries and wages allocation

6.2.4 Increased demand for housing, services and social facilities due to influx of migrant labour and job seekers

In a country with an unemployment rate of 26.7%, job seekers are continuously in search for employment prospects. Consequently, the knowledge of the proposed project will attract job seekers into the region. This influx, depending on its magnitude can place pressure on local government to provide housing, services and social facilities at a required pace. Additionally, in the case where employment expectations are not met, the possibility of informal settlement proliferation is highly likely. Therefore, it is recommended that the recruitment process is well managed and communicated.

Gaps in knowledge:

- Planned HR process.

6.2.5 Increase in theft related crimes due to high unemployment rate, social ills and increased movement of people in the area

As established, the most common incidents in the project area include stock theft, burglary and theft out of motor vehicle. The influx of labour may exacerbate this status if job expectations are not met. Furthermore, inequality, social ills and insufficient job opportunities have a correlation to crime. The construction phase will create additional movement of people and vehicles to the site, which can also increase the chances of theft. Moreover, during operations some electrical cables might be stolen as cable theft is rife throughout the country.

Gaps in knowledge:

- Perspectives of adjacent land owners on crime in the area

6.2.6 Increase in Government Revenue

A significant amount of government revenue will be derived from rates, payments of income taxes, payroll taxes and VAT amongst others as a result of the proposed project. This is a positive impact and will assist government in the improvement of socio-economic conditions for residents, albeit the exact allocations cannot be determined.

Gaps in knowledge:

- Amount of rates and taxes to be paid by the facility during operations

6.2.7 Possible Health Risks for employees due to Asbestos prevalence in region

The proposed project is located in close proximity to several rehabilitated, partially rehabilitated and un-rehabilitated asbestos mines, all of which continue to pose health risks to surrounding communities and land uses (Liebenberg-Weyers, 2010). Due to the carcinogenic nature of asbestos, numerous diseases can result due to exposure to the asbestos fibres for prolonged periods. Asbestosis is an occupational disease confined to the workplace wherein continuous inhalation of asbestos fibres weaken the lungs. An additional disease linked to asbestos is Mesothelioma, which occurs as a result of trivial exposure to asbestos fibres (Journeyman.tv, 2002).

No health statistics in terms of the number of asbestos related illnesses are available from the local and regional health facilities. Nonetheless, asbestosis was the third killer disease in the region after HIV and TB, which serves an indication of the possibly high prevalence of the disease (Journeyman.tv, 2002).

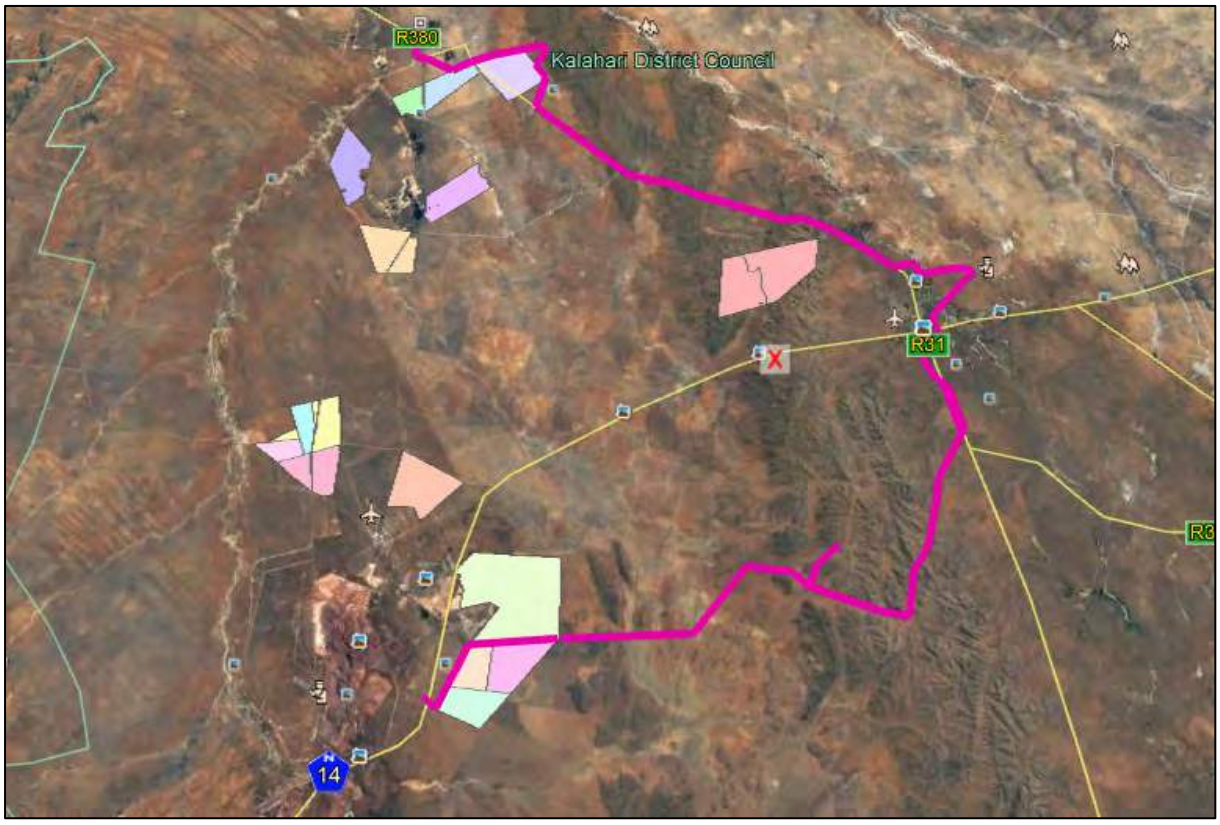
Moreover, secondary impacts emanating from asbestos pollution in the Northern Cape include materials contaminated with asbestos for a variety of purposes such as school playgrounds, sports fields, roads and buildings. Therefore, exposure has been and continues to be rampant for residents.

For the proposed project therefore, this is a potential negative impact particularly for the workers during the construction and operations phase of the Wind energy facility. From data gathered, it is deduced that prolonged exposure in the area for the workers increases their likelihood of acquiring asbestos related illnesses but reduces their risks to asbestosis as they will not be working within the asbestos mines. A portion of the proposed project site is within the asbestos no-go area due to the exposure of asbestos.

Gaps in knowledge:

- Statistics of asbestos related illnesses in the region
- Extent to which asbestos is a health hazard
    - Soil contamination potentially caused by wind carrier
    - Air quality

6.3 Cumulative Impacts



Map 0-8: Proposed and approved energy projects in 50km radius from proposed project site

6.3.1 Potential increase in crime and influx of job seekers

The region has in recent years experienced numerous theft related crimes. The proposed and approved projects amount to 20 energy projects and in summation will attract a large number of job seekers into the region. Numerous specialist working on other projects have noted the increased probability in stock theft as a result of the uncontrolled movement of people around the project site.

6.3.2 Change in sense of place

The region is characteristic of mining and limited activity, with villages and small towns. The 20 energy projects, if others are also approved, pose a shift in the current sense of place to a more industrial region.

6.3.3 Improved Energy Supply

The Windfarm will provide an important national service of providing new electricity capacity into the national grid. The windfarm will provide the important national service of providing new electricity capacity into the national grid. Increased access to energy would have a profound effect on curbing poverty and unemployment, attracts investment and essentially promotes socio-economic development and local economic development.

7 IMPACT ASSESSMENT SUMMARY

Below are the impact rating tables, separated into the construction phase, operations phase, decommissioning phase as well as cumulative impacts. These serve to summarise the afore-discussed impact s.

Table 2: Impact assessment summary table for the Construction Phase

Construction Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Direct Impacts													
Increase in production and GDP-R	Economy will be stimulated	Positive	National	TBD	Substantial	Very likely	High	NA	Procure locally, where feasible	Moderate	Moderate	5	Medium
Temporary employment	Unemployment figures will slightly decrease	Positive	National	TBD	Moderate	Very likely	High	NA	Offer skills development programme to serve energy market in region and create local employability	Low	Low	5	Medium
Skills development and enhancement	Skills levels in municipality and for benefitting individuals will improve	Positive	National	Permanent	Moderate	Likely	Low	NA	Offer skills development programme to serve energy market in region	Low	Low	5	High
Change in sense of place	The noise, vehicular movement and visual results of the construction activities will change the sense of place.	Negative	Site	TBD	Substantial	Likely	Moderate	Moderate	Adhere to noise and visual specialist recommendations.	Moderate	Low	3	Low

Construction Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Indirect Impacts													
Household income attainment	Employment in the construction of the windfarm will result in household income earnings for benefitting households.	Positive	National	TBD	Moderate	Likely	High	NA	Offer skills development programme to create local employability and thus local household earnings increase	Low	Low	4	High
Increased demand for housing, services and social facilities	The in-migration of migrant labour and job seekers will place pressure on local government in the provision of housing, services and social facilities.	Negative	Local	Medium term	Moderate	Likely	Moderate	Moderate	Manage recruitment process to control expectations and unnecessary in-migration	Low	Low	4	High
Increase in theft related crimes	The unmet expectations of job attainment and the large number of unemployed individuals increases the chances of theft related crimes.	Negative	Local	Short term	Substantial	Likely	Moderate	Moderate to high	Implement controlled access to project site.	Moderate	Low	5	High

Construction Phase												
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Potential health risks for employees due to asbestos prevalence	The inactive asbestos mines pose a health risk for personnel that will be working on site.	Negative	Regional	Short term	Slight	Unlikely	Low	Moderate	Air quality monitoring to determine risk levels which will dictate safety and health plan to be employed on site	Very low	Low	4	Low

Table 3: Impact assessment summary table for the Operational Phase

Operational Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Direct Impacts													
Increase in production and GDP-R	National economy will be stimulated due to the continuous operating expenditure	Positive	National	TBD	Moderate	Very likely	High	NA	Procure locally, where feasible	Low	Low	4	Medium

Operational Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Employment creation	Long term job opportunities will be made	Positive	National	TBD	Moderate	Very likely	High	NA	Offer skills development programme to serve energy market in region and create local employability	Low	Low	3	Medium
Skills development and enhancement	Skills levels in municipality and for benefitting individuals will improve	Positive	National	Permanent	Slight	Likely	Low	NA	Offer skills development programme to serve energy market in region and create local employability	Very low	Very low	4	Medium
Change in sense of place	The presence of 99 wind turbines will change the current sense of place through the visual impact.	Negative	Site	TBD	Substantial	Likely	Moderate	High	Strictly adhere to visual specialist recommendations	Moderate	Low	3	Medium
Indirect Impacts													

Operational Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Household income attainment	Employment in operations and maintenance of the windfarm will result in household income earnings for benefitting households.	Positive	Local	TBD	Moderate	Likely	High	NA	Offer skills development programme to create local employability and thus local household earnings increase	Low	Low	4	High
Increase in government revenue	The rates, payroll taxes and Value Added Tax paid to local government will increase government revenue	Positive	Local	TBD	Slight	Very likely	High	NA	No enhancement measures applicable.	Very low	Very low	N/A	Medium
Potential health risks for employees due to asbestos prevalence	The inactive asbestos mines pose a health risk for personnel that will be working on site	Negative	Regional	Short term	Slight	Unlikely	Low	Moderate	Air quality monitoring to determine risk levels which will dictate safety and health plan to be employed on site	Very low	Low	4	Low

Table 4: Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Direct Impacts													
Local Economy stimulation	The cost of the removal and disconnection of the wind turbines will stimulate economic activity.	Positive	Regional	TBD	Slight	Likely	High	NA	Procure locally, where feasible	Very low	Very low	4	Medium
Temporary employment creation	Job opportunities will be created	Positive	Regional	TBD	Slight	Likely	High	NA	Hire local labour from with experience in decommissioning which can be sourced from one of the numerous surrounding wind energy projects.	Very low	Very low	4	Medium

Decommissioning Phase													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Change in sense of place	The removal of 99 wind turbines that will have been located on the site for a long term duration will be removed and change the sense of place	Neutral	Site	TBD	Substantial	Very likely	High	High	Adhere to visual specialists' recommendations	Low	Low	3	Medium

Table 5: Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
Potential increase in crime	The unmet expectations of job attainment and the large number of unemployed individuals increases the	Negative	Regional	Medium term	Substantial	Likely	Moderate	Moderate	Implement controlled access to project site.	Moderate	Moderate	4	Medium

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
	chances of theft related crime on numerous approved and proposed energy sites												
Change in sense of place	The numerous energy development concentrated in this region will shift the identity of place to be more industrial.	Neutral	Regional	Long term	Substantial	Very likely	High	High	Adhere to visual specialist's recommendations	Moderate	Moderate	3	Medium
Demographic changes due to influx of job seekers	The influx into the region will possibly be immense due to the numerous projects in the area attracting migrant job seekers.	Negative	Regional	Medium term	Substantial	Likely	Low	Moderate	Manage recruitment process to control expectations and unnecessary in-migration	Moderate	Moderate	3	Medium
Improved energy supply and opportunities for LED	Phase 1 and 2 of the Kuruman Windfarm development	Positive	Regional	TBD	Substantial	Likely	High	NA	No enhancement measures applicable.	Moderate	Moderate	N/A	Medium

Cumulative Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Ranking of Residual Impact/ Risk	Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)		
	will proide an environmentally friendly form energy which will serve the economy in a positive manner.												

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Mulilo Renewable Project Developments (Pty) Ltd

NOISE REPORT

FOR SCOPING PURPOSES

Establishment of Phase 2 of the Kuruman Wind Farm close to Kuruman, Northern Cape Province

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Prepared by:

EAR
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Client:

Council of Scientific and Industrial Research for
Mulilo Renewable Project Developments (Pty) Ltd

PO Box 320
Stellenbosch
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Report no:

CSIR-MKWF2/SNR/201803-Rev 0

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Date:

March 2018

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EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Enviro-Acoustic Research cc was commissioned to undertake a specialist study to determine the potential noise impact on the surrounding environment due to the establishment of phase 2 of the Kuruman Wind Farm on various farms close to the town of Kuruman in the Northern Cape Province.

This scoping report is the result of the initial phase study (desktop) of the Environmental Impact Assessment (EIA) process investigating the potential noise impact that such a facility may have on the surrounding environment, highlighting methodologies, potential issues to be investigated as well as preliminary findings and recommendations.

PROJECT DESCRIPTION

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, "Mulilo") propose the development of a commercial wind energy facility near Kuruman, Northern Cape. The facility is to be developed in two phases, namely:

- Phase 1, with up to 47 wind turbines;
- Phase 2, with up to 52 wind turbines.

The wind energy market is fast changing and adapting to new technologies and site specific constraints. Optimizing the technical specifications can add value through, for example, minimizing environmental impact and maximizing energy yield. As such the developer has been evaluating several turbine models, however the selection will only be finalized at a later stage once a most optimal wind turbine are identified (factors such as meteorological data, price and financing options, guarantees and maintenance costs, etc. must be considered).

Each wind turbine will have a generating capacity of up to 4.5 MW with a hub height of up to 140m with a blade length of 80m.

DESCRIPTION OF AMBIENT SOUND LEVELS

The area was visited where a number of ambient baseline sound levels were measured. The data indicates that the area has the potential to be very quiet at night, though ambient sound levels increased as the wind speed increases. The visual character of the area is mainly rural and it was accepted that the SANS 10103 noise district classification could be rural for the study area (during periods of low winds).

SCOPING LEVEL NOISE IMPACT DETERMINATION AND FINDINGS

A basic sound propagation model was selected to illustrate that a noise-sensitive development/receptor could be impacted by the development of the proposed facility. This scoping level assessment indicated that there is a risk of a noise impact during the construction and operation phases due to the proximity to noise-sensitive receptors to the locations where noise generating activities may take place.

RECOMMENDATIONS

This assessment indicated that the proposed project could have a potential noise impact on the surrounding area as there are Noise-sensitive developments/receptors within the potential area of influence.

It is recommended that the potential noise impact associated with this wind energy facility be investigated in more detail in the Environmental Impact Assessment phase considering the project layout as well as the specifications of the selected wind turbines.

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Contents of this report in terms of Regulation GNR 326 of 2014, Appendix 6	**Cross-reference in this report**
(a) details of — the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	**Section 13**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Section 14** *(also separate document to this report)*
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**Section 1.1**
(cA) an indication of the quality and age of base data used for the specialist report;	**Section 3**
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**Section 3** and **7.3**
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**Section 3.2 and 3.3**
(e) a description of the methodology adopted in preparing the report or carrying out the specialized process inclusive of equipment and modeling used;	**Section 1.6**
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	**Sections 1.3.6**
(g) an identification of any areas to be avoided, including buffers;	**Section 8.2**
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**Buffer proposed to prevent high significance impact, see Figure 10-1**
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**Section 6**
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	**Section 8**
(k) any mitigation measures for inclusion in the EMPr;	To be included in EIA
(l) any conditions for inclusions in the environmental authorization;	To be included in EIA
(m) any monitoring requirements for inclusion in the EMPr or environmental authorization;	To be included in EIA
(n) a reasoned opinion - whether the proposed activity, activities or portions thereof should be authorized regarding the acceptability of the proposed activity or activities;	Future EIA to be compiled, to be included in EIA

- regarding the acceptability of the proposed activity or activities; and - if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o) a description of any consultation process that was undertaken during the course of the preparing the specialist report;	**Section 1.5**
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**Section 1.5**
(q) any other information requested by the competent authority.	None requested

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GLOSSARY OF ABBREVIATIONS

ECA	Environment Conservation Act (Act 78 of 1989)
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
IAPs	Interested and Affected Parties
i.e.	that is
km	kilometres
m	Meters (measurement of distance)
m^2	Square meter
m^3	Cubic meter
mamsl	Meters above mean sea level
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NCR	Noise Control Regulations (under Section 25 of the ECA)
SABS	South African Bureau of Standards
SANS	South African National Standards
SHEQ	Safety Health Environment and Quality
WF	Wind Farm / Wind Energy Facility
WHO	World Health Organisation
WTG	Wind Turbine Generator

1 INTRODUCTION

1.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research cc was commissioned to undertake a specialist study to determine the potential noise impact on the surrounding environment due to the proposed establishment of phase 2 of the Kuruman Wind Farm (WF) on various farms in the vicinity of Kuruman in the Northern Cape Province.

This report is the result of the initial phase study (desktop) of the Environmental Impact Assessment (EIA) process investigating the potential noise impact that such a facility may have on the surrounding environment, highlighting methodologies, potential issues to be investigated as well as preliminary findings and recommendations.

It is important to note this document is only the Scoping Document for Phase 1. Being preliminary, the report presents conceptual scenarios to illustrate important concepts.

1.2 BRIEF PROJECT DESCRIPTION

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, "Mulilo") propose the development of a commercial wind energy facility near Kuruman, Northern Cape (refer to **Figure 1-1**). The facility is to be developed in two phases, namely:

- Phase 1, with up to 47 wind turbines;
- Phase 2, with up to 52 wind turbines.

The wind energy market is fast changing and adapting to new technologies and site specific constraints. Optimizing the technical specifications can add value through, for example, minimizing environmental impact and maximizing energy yield. As such the developer has been evaluating several turbine models, however the selection will only be finalized at a later stage once a most optimal wind turbine are identified (factors such as meteorological data, price and financing options, guarantees and maintenance costs, etc. must be considered).

Each wind turbine will have a generating capacity of up to 4.5 MW with a hub height of up to 140m with a blade length of 80m. Other infrastructure associated with the proposed wind energy facility may include:

- A number of temporary construction yards;
- A laydown area next to the locations of the proposed wind turbines;
- Foundations to support the wind turbines;

- Cabling between the turbines, to be lain underground where practical, which will connect to one or more on-site substations;
- Connection to the main Eskom Grid through a 132kV transmission line from the on-site substation (two alternatives are being investigated);
- Existing roads will be used as far as possible. However, where required, internal access roads will be constructed between the turbines; and
- Offices, storage and workshop area for maintenance and storage purposes.

1.3 STUDY AREA

The study area is further described in terms of environmental components that may contribute or change the sound character in the area.

1.3.1 Topography

The WF is proposed to be developed in an area that can be defined as hills, with flat plains around the hills. The height above mean sea level ranges between 1,360 to 1,600 mamsl.

1.3.2 Roads and rail roads

There are no major roads close to the proposed facility. There are a number of small gravel roads traversing the area but traffic on them is considered to be insignificant.

1.3.3 Land use

The land use is mainly agricultural with small farming communities living on the farms. As the night-time noise environment is of particular interest in this document, current land use activities are not expected to impact on the current ambient sound environment.

1.3.4 Residential areas

There is no residential area close to the proposed development.

1.3.5 Ground conditions and vegetation

The area falls within the Kalahari Mountain Bushveld with the area vegetated with grasses, sedges, bushes and some trees. Due to the drought, vegetation was generally sparse.

Based on measurements collected at operational wind farms, as well as recommendations for a number of studies, a ground surface factor of 75% will be used for any noise propagation modelling. It should be noted that this factor is only relevant for air-borne waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

1.3.6 Existing Ambient Sound Levels

The area is undeveloped with a rural character. Ambient sound levels would be typical of a rural noise district. Ambient sound levels were measured during February 2018 with the noise measurements discussed **section 3.3**.

1.4 NOISE-SENSITIVE DEVELOPMENTS

Available topographical maps was used to identify potential Noise-sensitive developments (NSD) in the area (within the area proposed, as well as potential NSD's up to 2 km from boundary of the facility). The data was imported into GoogleEarth® to allow a more visual view of the areas where Noise-sensitive developments were identified. The assessment indicated there are a number of such developments that occur in the area. Noise-sensitive developments as identified are highlighted in **Figure 1-2**.

1.5 COMMENTS PREVIOUSLY RECEIVED

The author does not know about any issues or comments received with regards with the proposed project.

1.6 TERMS OF REFERENCE

A noise impact assessment must be completed for the following reasons:

- If there are potential noise-sensitive receptors staying within 1,000 m from industrial activities (SANS 10328:2008);
- If there are potential noise-sensitive receptors staying within 2,000 m from any wind turbine (SANS 10328:2008);
- It is a controlled activity in terms of the NEMA regulations and a ENIA is required, because:
    - It may cause a disturbing noise that is prohibited in terms of section 18(1) of the Government Notice 579 of 2010; and
- It is generally required by the local or district authority as part of the environmental authorisation or planning approval in terms of Regulation 2(d) of GN R154 of 1992 (Regulation 4(1) in terms of PN.200 of 2013 – Western Cape).

In addition, Appendix 6 of GN 326 of December 2014 (Gov. Gaz. 38282), issued in terms of the National Environmental Management Act, No. 107 of 1998 also defines minimum information requirements for specialist reports.

In South Africa the document that addresses the issues specifically concerning environmental noise is SANS 10103:2008. It has been thoroughly revised and brought in line with the guidelines of the World Health Organisation (WHO) during 2006 - 2007. It provides the maximum average ambient noise levels during the day and night to which different types of developments may be exposed.

In addition, the SANS 10328:2008 standard specifies the methodology to assess the potential noise impacts on the environment due to a proposed activity that might impact on the environment. This standard also stipulates the minimum requirements to be investigated for Scoping purposes. These minimum requirements are:

1. The purpose of the investigation;
2. A brief description of the planned development or the changes that are being considered;
3. A brief description of the existing environment;
4. The identification of the noise sources that may affect the particular development, together with their respective estimated sound pressure levels or sound power levels (or both);
5. The identified noise sources that were not taken into account and the reasons why they were not investigated;
6. The identified noise-sensitive developments and the estimated impact on them;
7. Any assumptions made with regard to the estimated values used;
8. An explanation, either by a brief description or by reference, of the methods that were used to estimate the existing and predicted rating levels;
9. The location of the measurement or calculation points, i.e. a description, sketch or map;
10. Estimation of the environmental noise impact;
11. Alternatives that were considered and the results of those that were investigated;
12. A list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation;
13. A detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them;
14. Conclusions that were reached;
15. Recommendations, i.e. if there could be a significant impact, or if more information is needed, a recommendation that an environmental noise impact assessment be conducted, and;
16. If remedial measures will provide an acceptable solution which would prevent a significant impact, these remedial measures should be outlined in detail and

included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority.

In addition, the Scoping report should contain sufficient information to allow the Environmental Assessment Practitioner (EAP) to compile the Plan of Study for Environmental Impact Assessment (EIA), including the Noise component.

In this regard the following will be included to assist the EAP in the compilation of the Plan of Study (PoS) for the EIA:

- Details regarding the methodology followed to estimate and assess the potentially significant impacts during the EIA phase;
- The potential impact will be evaluated (where possible) in terms of the nature (description of what causes the effect, what/who might be affected and how it/they might be affected) as well as the extent of the impact. This will be done by means of a site visit, where appropriate ambient sound levels will be determined and the identification of potential noise-sensitive developments/areas;
- Calculation of projected noise levels at the residences of identified NSD using sound propagation algorithms. The projected noise levels will be used to define the potential magnitude or severity of the noise impact as per the criteria defined in this report; and
- A statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts will be included in the EIA.

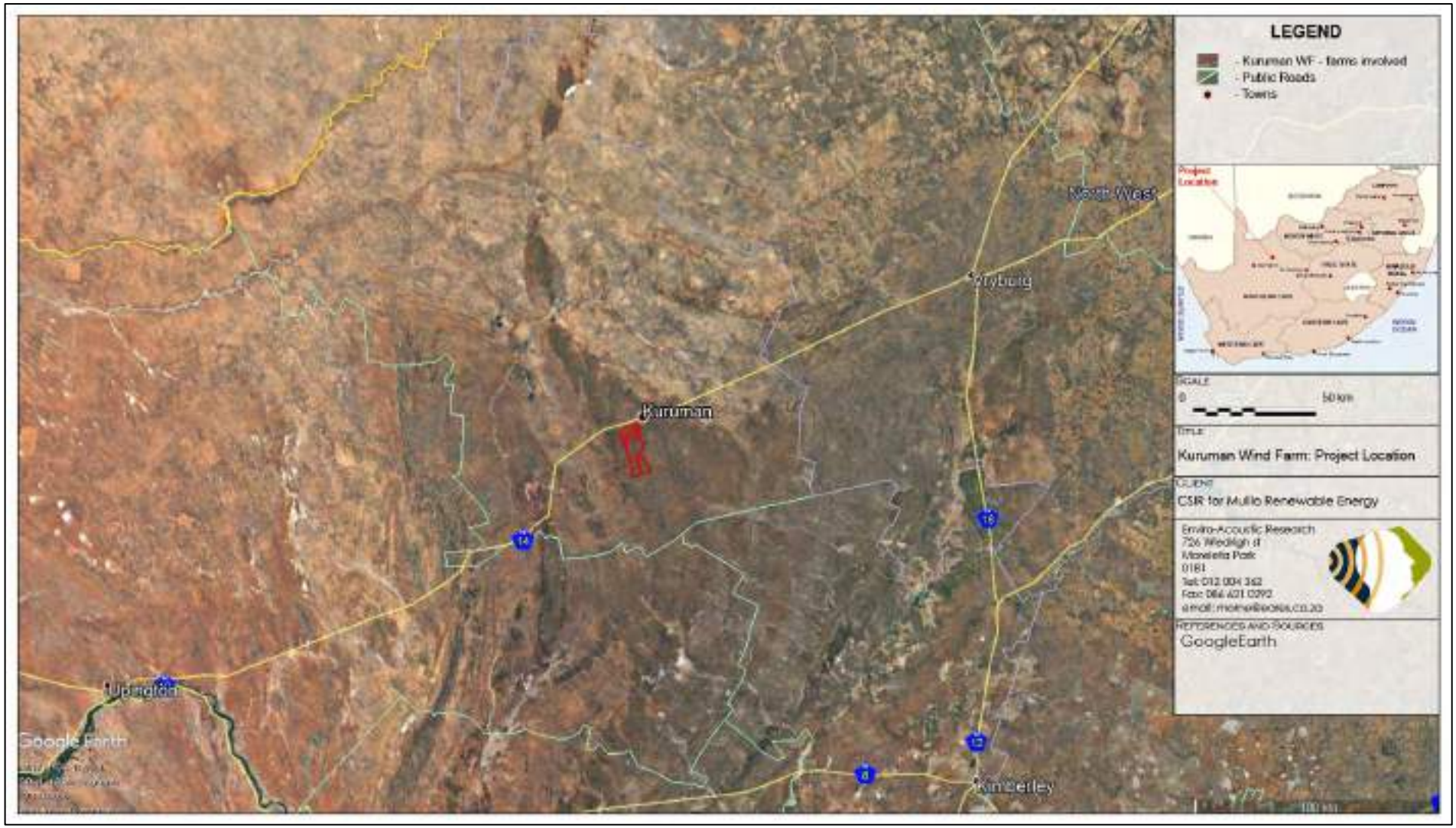

Figure 1-1: Site map indicating the location of proposed Kuruman WF project site

Figure 1-2: Aerial Image indicating Noise-sensitive developments within 2,000 m from Kuruman WF, Phase 2

2 POLICIES AND THE LEGAL CONTEXT

2.1 THE REPUBLIC OF SOUTH AFRICA CONSTITUTION ACT ("THE CONSTITUTION")

The environmental right contained in section 24 of the Constitution provides that everyone is entitled to an environment that is not harmful to his or her well-being. In the context of noise, this requires a determination of what level of noise is harmful to the well-being of humans. The general approach of the common law is to define an acceptable level of noise as that which the reasonable person can be expected to tolerate in the particular circumstances. The subjectivity of this approach can be problematic, however this has led to the development of noise standards (see Section 2.5).

"Noise pollution" is specifically included in Part B of Schedule 5 of the Constitution, which means that noise pollution control is a local authority competence, provided that the local authority concerned has the capacity to carry out this function.

2.2 THE ENVIRONMENT CONSERVATION ACT

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Minister of Water and Environmental Affairs") to make regulations regarding noise, among other concerns. The Minister has implemented noise control regulations under the ECA, adopted in Provincial Notice 200 of 2013 by the Western Cape Provincial Authority.

2.2.1 Noise Control Regulations (GN R154 of 1992)

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. The National Regulations will be in effect in the Northern Cape Province.

The National Noise Control Regulations (GN R154 1992) define:

"**Controlled area**" as:

A piece of land designated by a local authority where, in the case of--

c) Industrial noise in the vicinity of an industry-

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or
ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 meters, but not more than 1,4 meters, above the ground for a period of 24 hours, exceeds 61 dBA;

"**disturbing noise**" as:
Noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

"**zone sound level**" as:
A derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. *This is the same as the Rating Level as defined in SANS 10103:2008.*

In addition:
In terms of Regulation 2 -
"A local authority may –
(c): if a noise emanating from a building, premises, vehicle, recreational vehicle or street is a disturbing noise or noise nuisance, or may in the opinion of the local authority concerned be a disturbing noise or noise nuisance, instruct in writing the person causing such noise or who is responsible therefor, or the owner or occupant of such building or premises from which or from where such noise emanates or may emanate, or all such persons, to discontinue or cause to be discontinued such noise, or to take steps to lower the lever of the noise to a level conforming to the requirements of these Regulations within the period stipulated in the instruction: Provided that the provisions of this paragraph shall not apply in respect of a disturbing noise or noise nuisance caused by rail vehicles or aircraft which are not used as recreational vehicles;
(d): before changes are made to existing facilities or existing uses of land or buildings, or before new buildings are erected, in writing require that noise impact assessments or tests are conducted to the satisfaction of that local authority by the owner, developer, tenant or occupant of the facilities, land or buildings or that, for the purposes of regulation 3(b) or (c), reports or certificates in relation to the noise impact to the satisfaction of that local authority are submitted by the owner, developer, tenant or occupant to the local authority on written demand";

In terms of Regulation 4 of the Noise Control Regulations:

"No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof".

2.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

The National Environmental Management Act ("NEMA") defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating the WF to prevent noise pollution occurring. NEMA sets out measures which may be regarded as reasonable. They include measures:

1. to investigate, assess and evaluate the impact on the environment;
2. to inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment;
3. to cease, modify or control any act, activity or process causing the pollution or degradation;
4. to contain or prevent the movement of;
5. to eliminate any source of the pollution or degradation; or
6. to remedy the effects of the pollution or degradation.

2.4 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT ("AQA")

Section 34 of the National Environmental Management: Air Quality Act (Act 39 of 2004) 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; and

(ii) the maximum levels of noise.

(2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.

This section of the Act is in force but no such standards have yet been promulgated.

An atmospheric emission license issued in terms of section 22 may contain conditions in respect of noise. This however will not be relevant to the WF.

2.4.1 Draft Model Air Quality Management By-law for adoption and adaptation by Municipalities

Draft model air quality management by-laws for adoption and adaptation by municipalities was published by the Department of Environmental Affairs in the Government Gazette of 15 July 2009 as General Notice (for comments) 964 of 2009. Section 18 specifically focuses on Noise Pollution Management, with sub-section 1 stating:

"*No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, animal, machine, device or apparatus or any combination thereof.*"

The draft regulations differ from the current provincial Noise Control Regulations as it defines a disturbing noise as a noise that is measurable or calculable of which the rating level exceeds the equivalent continuous rating level as defined in SANS 10103.

2.5 NOISE STANDARDS

Four South African Bureau of Standards (SABS) scientific standards are considered relevant to noises 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 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. 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.*

2.6 INTERNATIONAL GUIDELINES

While there exist a number of international guidelines and standards that could encompass a document in itself, the three mentioned below were selected as they are used by different countries in the subject of environmental noise management, with the last two documents specifically focussing on the noises associated by wind energy facilities.

2.6.1 Guidelines for Community Noise (WHO, 1999)

The World Health Organization's (WHO) document on the *Guidelines for Community Noise* is the outcome of the WHO- expert task force meeting held in London, United Kingdom, in April 1999. It is based on the document entitled "Community Noise" that was prepared for the World Health Organization and published in 1995 by the Stockholm University and Karolinska Institute.

The scope of the WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments.

Guidance on the health effects of noise exposure of the population has already been given in an early publication of the series of Environmental Health Criteria. The health risk to humans from exposure to environmental noise was evaluated and guidelines values derived. The issue of noise control and health protection was briefly addressed.

The document uses the L_{Aeq} and $L_{A,max}$ descriptors to define noise levels. This document was important in the development of the SANS 10103 standard.

2.6.2 The Assessment and Rating of Noise from Wind Farms (ETSU, 1997)

This report describes the findings of a Working Group on Wind Turbine Noise, facilitated by the United Kingdom Department of Trade and Industry. It was developed as an Energy Technology Support Unit[1] (ETSU) project. The aim of the project was to provide information and advice to developers and planners on noise from wind turbines. The report represents the consensus view of a number of experts (experienced in assessing and controlling the environmental impact of noise from wind farms). Their findings can be summarised as follows:

1. Absolute noise limits applied at all wind speeds are not suited to wind farms; limits set relative to the background noise (including wind as seen in **Figure 7-3**) are more appropriate
2. $L_{A90,10mins}$ is a much more accurate descriptor when monitoring ambient and turbine noise levels

[1] ETSU was set up in 1974 as an agency by the United Kingdom Atomic Energy Authority to manage research programmes on renewable energy and energy conservation. The majority of projects managed by ETSU were carried out by external organizations in academia and industry. In 1996, ETSU became part of AEA Technology plc which was separated from the UKAEA by privatisation.

3. The effects of other wind turbines in a given area should be added to the effect of any proposed wind energy facility, to calculate the cumulative effect
4. Noise from a wind energy facility should be restricted to no more than 5 dBA above the current ambient noise level at a NSD. Ambient noise levels is measured onsite in terms of the $L_{A90,10min}$ descriptor for a period sufficiently long enough for a set period
5. Wind farms should be limited within the range of 35dBA to 40dBA (day-time) in a low noise environment. A fixed limit of 43 dBA should be implemented during all night time noise environments. This should increase to 45 dBA (day and night) if the NSD has financial investments in the wind energy facility
6. A penalty system should be implemented for wind turbine/s that operates with a tonal characteristic

This is likely the guideline used in the most international countries to estimate the potential noise impact stemming from the operation of a Wind Energy Facility. It also recommends an improved methodology (compared to a fixed upper noise level) on determining ambient sound levels in periods of higher wind speeds, critical for the development of a wind energy facility. Because of its international importance, the methodologies used in the ETSU R97 document will be recommended in this Scoping Report for implementation during the Environmental Noise Impact Assessment phase should projected noise levels (from the proposed WF at PSRs) exceed the zone sound levels as recommended by SANS 10103:2008.

2.6.3 Noise Guidelines for Wind Farms (MoE, 2008)

This document establishes the sound level limits for land-based wind power generating facilities and describes the information required for noise assessments and submissions under the Environmental Assessment Act and the Environmental Protection Act, Canada.

The document defines:

- Sound Level Limits for different areas (similar to rural and urban areas), defining limits for different wind speeds at 10 m height, refer also **Table 2-1**[2]
- The Noise Assessment Report, including;
    - Information that must be part of the report
    - Full description of noise sources
    - Adjustments, due to the wind speed profile (wind shear)

[2]The measurement of wind induced background sound level is not required to establish the applicable limit. The wind induced background sound level reference curve was determined by correlating the A-weighted ninetieth percentile sound level (L90) with the average wind speed measured at a particularly quiet site. The applicable Leq sound level limits at higher wind speeds are given by adding 7 dB to the wind induced background L90 sound level reference values

- The identification and defining of potential sensitive receptors
- Prediction methods to be used (ISO 9613-2)
- Cumulative impact assessment requirements
- It also defines specific model input parameters
- Methods on how the results must be presented
- Assessment of Compliance (defining magnitude of noise levels)

Table 2-1: Summary of Sound Level Limits for Wind Farms (MoE)

Wind speed (m/s) at 10 m height	4	5	6	7	8	9	10
Wind Turbine Sound Level Limits, Class 3 Area, dBA	40	40	40	43	45	49	51
Wind Turbine Sound Level Limits, Class 1 & 2 Areas, dBA	45	45	45	45	45	49	51

The document used the $L_{Aeq,1h}$ noise descriptor to define noise levels.

It should be noted that these Sound Level Limits are included for the reader to illustrate the criteria used internationally. Due to the lack of local regulations specifically relevant to wind energy facilities this criteria will also be considered during the determination of the significance of the noise impact.

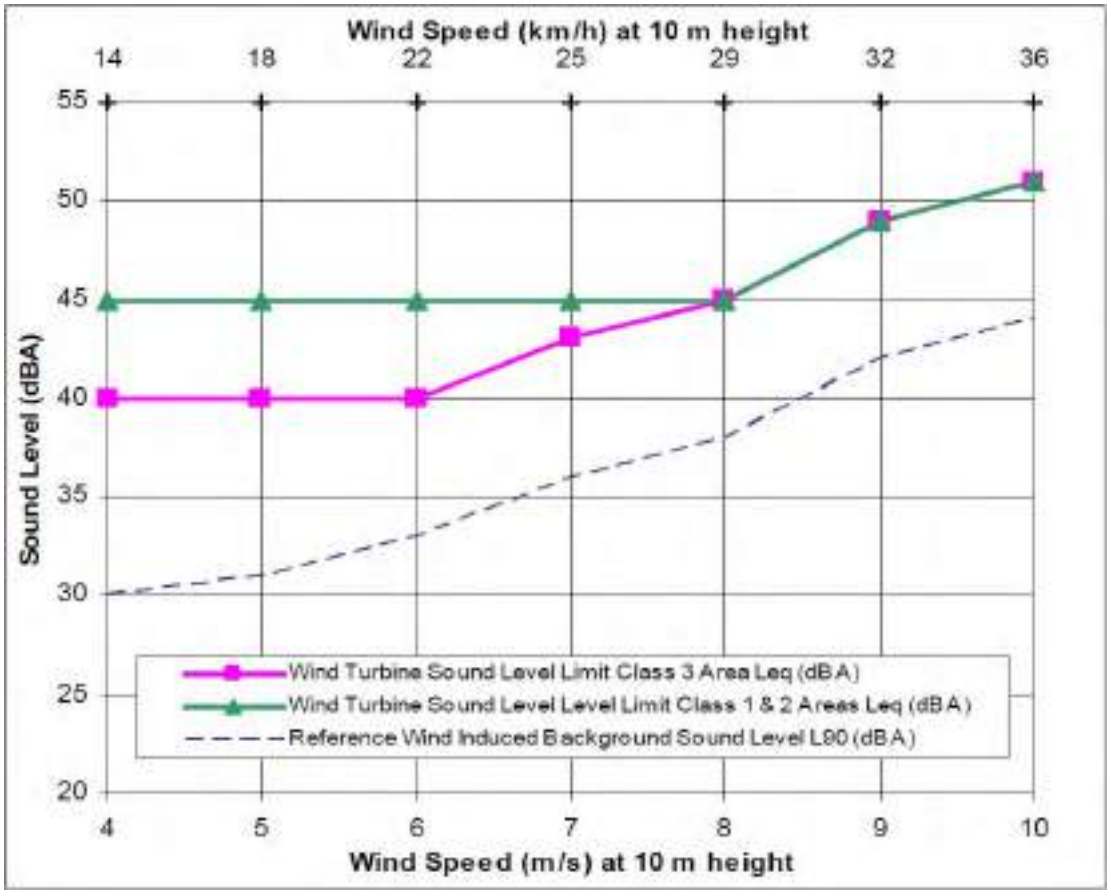

Figure 2-1: Summary of Sound Level Limits for Wind Turbines (MoE Canada)

2.6.4 Equator Principles

The **Equator Principles** (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Equator Principles Financial Institutions (EPFIs) commit to not providing loans to projects where the borrower will not or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

The Equator Principles were developed by private sector banks and were launched in June 2003. The banks chose to model the Equator Principles on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). 67 financial institutions (October 2009) have adopted the Equator Principles, which have become the de facto standard for banks and investors on how to assess major development projects around the world. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the International Finance Corporation Environmental, Health and Safety (EHS) Guidelines.

2.6.5 IFC: General EHS Guidelines – Environmental Noise Management

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principle.

It states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at the source.

It goes as far as to propose methods for the prevention and control of noise emissions, including:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment casing radiating noise;
- Improving the acoustic performance of constructed buildings, apply sound insulation;
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the

barrier. Barriers should be located as close to the source or to the receptor location to be effective;

- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas ;
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Placement of permanent facilities away from community areas if possible;
- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

It sets noise level guidelines (see **Table 2.2**) as well as highlighting the certain monitoring requirements pre- and post-development.

Table 2.2: IFC Table .7.1-Noise Level Guidelines

Receptor type	One hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The document uses the $L_{Aeq,1\ hr}$ noise descriptors to define noise levels. It does not determine the detection period, but refers to the IEC standards, which requires the fast detector setting on the Sound Level Meter during measurements for Europe.

3 ENVIRONMENTAL SOUND CHARACTER

3.1 INFLUENCE OF WIND ON AMBIENT SOUND LEVELS

Natural sounds have been a part of the environmental noise surrounding humans. In rural areas the sounds from insects and birds would dominate the ambient sound character, with noises as wind flowing through vegetation increasing as wind speed increases. Work by Fégeant (2002) stressed the importance of wind speed and turbulence causing variations in the level of vegetation generated noise. In addition, factors such as the season (e.g. dry or no leaves versus green leaves), the type of vegetation (e.g. grass, conifers, deciduous), the vegetation density, as well as the total vegetation surface, all determine both the sound level as well as spectral characteristics.

While the total ambient sound levels are of importance, the spectral characteristics also determines the likelihood that someone will hear external noises that may or may not be similar in spectral characteristics to that of vegetation created noise. Bolin (2006) did investigate spectral characteristics and determined the annoyance might occur at levels where noise generated by wind turbine noise exceeds natural ambient sounds with 3dB or more.

Unfortunately, current regulations and standards do not consider changing ambient sound levels due to natural events, such as can be found near the coast (from the ocean waves) or areas where wind induced noises (from vegetation) are prevalent, which is unfeasible with wind energy facilities, as these facilities will only operate when the wind is blowing. It is therefore important that the impact of wind-induced noises be considered when determining the impact of an activity such as a wind energy facility. This is discussed further in **Section 7.3.3**.

3.2 AMBIENT SOUND MEASUREMENTS PROCEDURE

The measurement of ambient sound levels is defined by the South African National Standard SANS 10103:2008 as: "***The measurement and rating of environmental noise with respect to land use, health, annoyance and speech communication***". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and
- weather conditions.

As discussed in the previous section, ambient sound measurements are ideally collected when wind speeds are less than 3m/s with no measurements collected when wind speeds exceed 5m/s. Due to the fact that wind energy facilities will only be in operation during periods that the wind is blowing, it is critical that ambient sound level measurements reflect expected sound levels at various wind speeds. Because of the complexity of these measurements the following methodology is followed:

- Compliance with the latest version of SANS 10103;
- The sound measuring equipment was calibrated directly before, and directly after the measurements was collected. In all cases drift[3] was less than 0.2 dBA between these two measurements.
- The measurement equipment made use of a windshield specifically designed for outdoor use during increased wind speeds;
- The areas where measurements were recorded was selected so as to minimize the risks of direct impacts by the wind on the microphone;
- Measurements took place in 10-minute bins for at least two full night-time periods;
- Noise data was synchronised with the wind data measured onsite using an anemometer at a 1.5 m height.

Ambient sound levels were measured over a period of a few nights during February 2018 at four locations. The locations used to measure ambient (background) sound levels presented in **Figure 3-1** for the larger Kuruman WF. Photos taken during the measurement date is presented in **Appendix B**.

[3] Changes in instrument readings due to a change in altitude (air pressure), temperature and humidity

Figure 3-1: Localities of where ambient sound levels were measured

3.3 AMBIENT SOUND MEASUREMENTS COLLECTED IN AREA

3.3.1 Measurement Point MKWFASLT01

The equipment defined in **Table 3-1** was used for gathering data at this location. Measured sound levels are presented in **Figure 3-2** and **Figure 3-3** and defined in **Table 3-2**.

Table 3-1: Equipment used to measure sound levels at MKWFASLT01

Equipment	Model	Serial no	Calibration Date
SLM	Svan 977	34849	October 2017
Microphone	ACO Pacific 7052E	55974	October 2017
Calibrator	Quest CA-22	J 2080094	June 2016
Anemometer	W3081	-	-

* Microphone fitted with the RION WS-03 outdoor all-weather windshield.

The measurement location was selected to be reflective of the typical environmental ambient sound levels that the receptors living in this area may experience. The SLM was erected in a fenced-off area away from the house, approximately halfway between the main dwelling and a number of dwellings used by the workers. There was a cattle enclosure approximately 25m from the microphone, with a number of fruit trees within 5 meters.

It was reported that the main residential dwelling was seldom used. The workers were busy in the area tending to the cattle with their voices audible at times. Birds communication was generally dominant. Some wind induced noises at times with wind gusts with the sound originating from the large eucalyptus trees around 50m away at the house. Cattle clearly audible and noisy at times.

Refer to Appendix B for a photo of this measurement location. Sounds heard during the period the instrument was deployed and collected (approximately 60 – 80 minutes) are defined in **Table 3-2**.

Table 3-2: Noises/sounds heard during site visits at receptor MKWFASLT01

		During Deployment	During Collection
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating or clearly audible**	**Faunal and natural**	Bird communication. Cattle at times. Wind-induced noises.	Bird communication. Cattle at times.
	Residential	Voices at times from workers.	Voices at times from workers.
	Industrial & transportation	-	-

Impulse equivalent sound levels (South African legislation): Figure 3-2 illustrates how the impulse-weighted 10-minute equivalent values changes over time with **Table 3-3**

defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown on **Figure 3-2** with **Table 3-3** defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. L_{A90} is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time on **Figure 3-3** and defined in **Table 3-3**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Table 3-3** and illustrated in **Figure 3-3**.

Table 3-3: Sound levels considering various sound level descriptors at MKWFASLT01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	51	48	34	-	-
Night arithmetic average	-	46	41	33	-	-
Day minimum	-	37	31	-	9	-
Day maximum	88	66	61	-	-	-
Night minimum	-	30	22	-	9	-
Night maximum	70	62	57	-	-	-
Day 1 equivalent	-	51	47	-	-	Late afternoon and evening only
Night 1 Equivalent	-	49	44	-	-	8 hour night equivalent average
Day 2 equivalent	-	56	49	-	-	16 hour day equivalent average
Night 2 Equivalent	-	55	50	-	-	8 hour night equivalent average
Day 3 equivalent	-	44	37	-	-	Most of day

Bird sounds significantly dominated the soundscape, with wind-induced noises increasing the noise levels at times during wind gusts. Cattle were clearly audible and very loud at times. Considering the development character and sounds heard, the area can be considered naturally quiet.

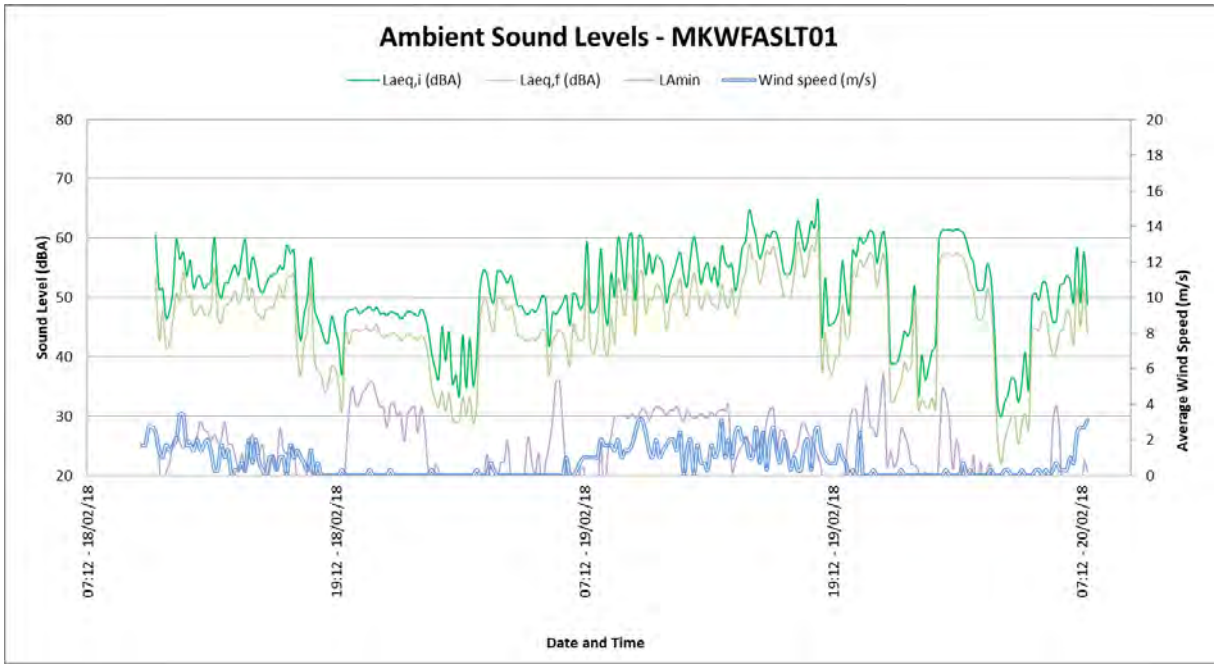

Figure 3-2: Ambient Sound Levels at MKWFASLT01

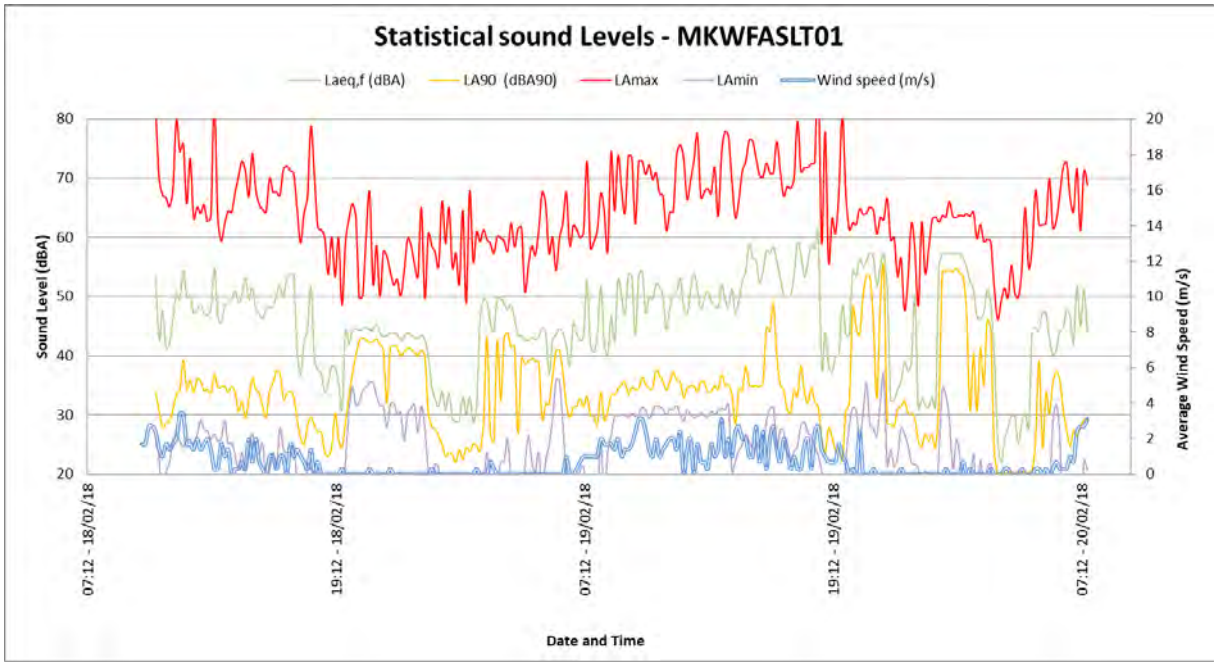

Figure 3-3: Maximum, minimum and statistical values at MKWFASLT01

Third octaves were measured and are displayed in the following figures. Wind-induced noises had a significant impact on most of the measurements.

Lower frequency (20 – 250 Hz) – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relative smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies.

Night-time data indicated a site with little acoustic energy in this frequency range (average of less than 10 dBA).

Daytime data shows some acoustic energy in this frequency band, with some energy due to wind-induced noises. There were peaks at 100 and 200Hz during the daytime, with the evening measurements having a sound character typical of the night-time period (average of approximately 29 dBA).

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz; mostly below 1,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally features in 630 – 1,600 Hz range.

Night-time data indicate a site with little acoustic energy in this frequency range (average of approximately 21 dBA).

Daytime data shows some acoustic energy in this frequency band. There were a number of measurements that indicated sounds from various different sources with a significant peak at 250 Hz (average of approximately 41 dBA).

Higher frequency (2,000 Hz upwards) – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt etc. There were significant peaks in the 3 150 – 6 300 frequency bands both night and day, likely from birds and insects.

Night-time data indicate significant acoustic energy in this frequency range (average of approximately 41 dBA).

Daytime data indicate significant acoustic energy in this frequency band (average of approximately 44 dBA).

Compliance with international guidelines: While the sound levels are elevated and higher than the sound levels typical of a rural area, it was mainly due to natural sounds, typical of spring and summer seasons. Considering the developmental character of the area, the acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008.

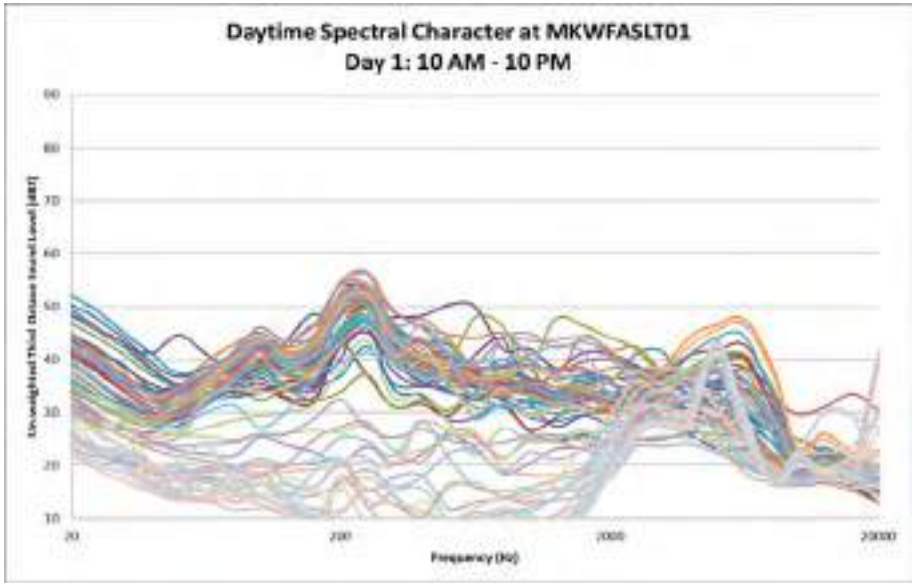

Figure 3-4: Spectral frequencies – MKWFASLT01, Day 1

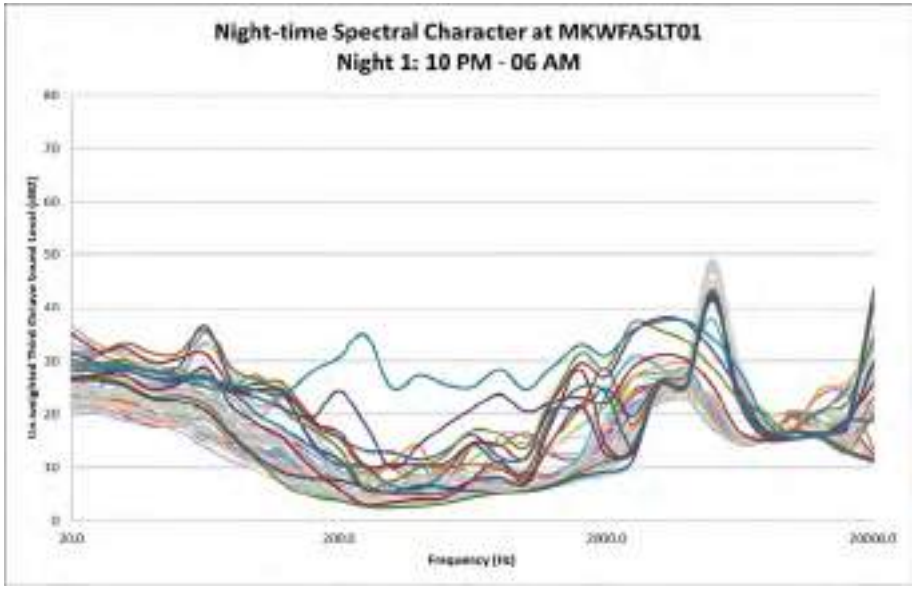

Figure 3-5: Spectral frequencies – MKWFASLT01, Night 1

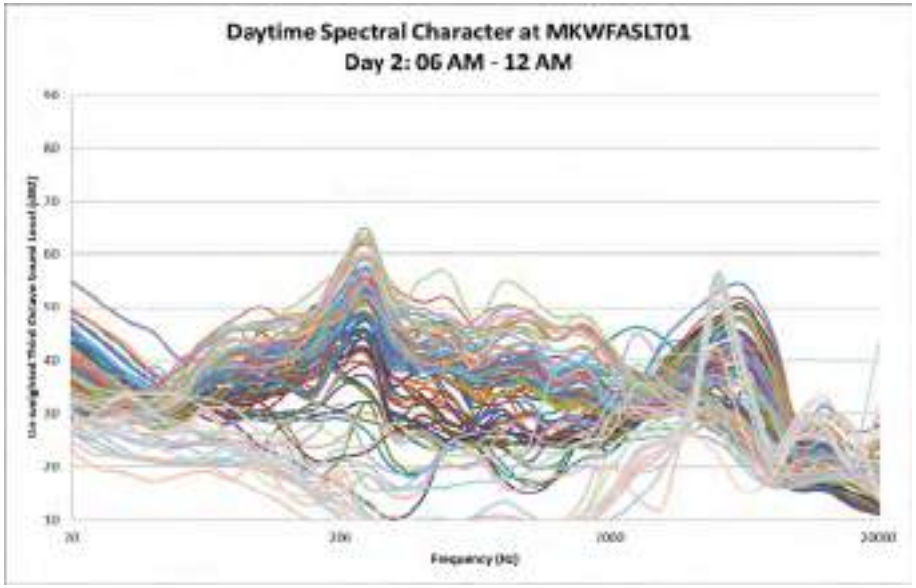

Figure 3-6: Spectral frequencies – MKWFASLT01, Day 2

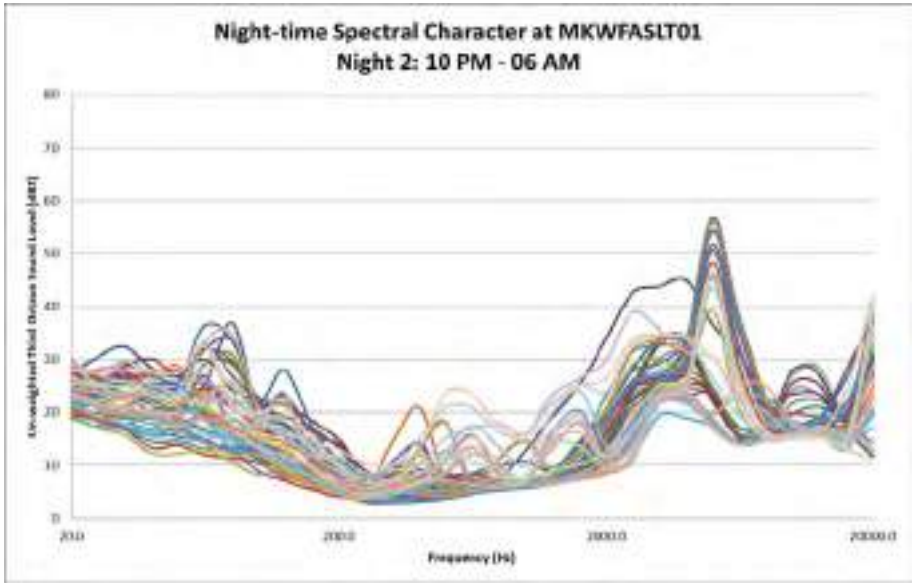

Figure 3-7: Spectral frequencies – MKWFASLT01, Night 2

3.3.2 Measurement Point MKWFASLT02

The equipment defined in **Table 3-4** was used for gathering data. Measured sound levels are presented in **Figure 3-8** and **Figure 3-9** and defined in **Table 3-6**.

Table 3-4: Equipment used to measure sound levels at MKWFASLT02

Equipment	Model	Serial no	Calibration Date
SLM	Svan 977	36176	December 2017
Microphone	ACO Pacific 7052E	49596	December 2017
Calibrator	Quest CA-22	J 2080094	June 2017

The SLM was erected in a relatively open area in front of the house. Refer to Appendix B for a photo of this measurement location. There were a number of very large trees close to the house with wind induced sounds clearly audible during increased winds. Sounds heard during the period the instrument was deployed and collected (approximately 60 – 80 minutes) are defined in **Table 3-5**.

Table 3-5: Noises/sounds heard during site visits at receptor MKWFASLT02

		During Deployment	During Collection
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating or clearly audible**	**Faunal and natural**	Bird calls dominate. Wind-induced noises at times. Insects audible.	Bird communication.
	Residential	Sound of TV or radio playing in house	-
	Industrial & transportation	-	-

Impulse equivalent sound levels (South African legislation): Figure 3-8 illustrates how the impulse-weighted 10-minute equivalent values changes over time with **Table 3-6** defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown on **Figure 3-8** with **Table 3-6** defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. L_{A90} is a statistical indicator that describes the noise level that is exceeded 90% of

the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time on **Figure 3-9** and defined in **Table 3-6**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Table 3-6** and illustrated in **Figure 3-9**.

Table 3-6: Sound levels considering various sound level descriptors at MKWFASLT02

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	47	41	30	-	-
Night arithmetic average	-	43	40	34	-	-
Day minimum	-	29	26	-	21	-
Day maximum	91	72	65	-	-	-
Night minimum	-	35	31	-	23	-
Night maximum	74	59	51	-	-	-
Day 1 equivalent	-	56	50	-	-	Evening only
Night 1 Equivalent	-	48	42	-	-	8 hour night equivalent average
Day 2 equivalent	-	49	43	-	-	16 hour day equivalent average
Night 2 Equivalent	-	49	45	-	-	8 hour night equivalent average
Day 3 equivalent	-	52	46	-	-	16 hour day equivalent average
Night 3 Equivalent	-	46	41	-	-	8 hour night equivalent average
Day 4 equivalent	-	52	46	-	-	16 hour day equivalent average
Night 4 Equivalent	-	45	40	-	-	8 hour night equivalent average
Day 5 equivalent	-	54	47	-	-	Daytime

Bird communication and wind-induced noises dominated the soundscape. Insects were just audible. The data indicated an area with increased noise levels at night, but the noises are mainly from natural origin. As such the area can be considered naturally quiet.

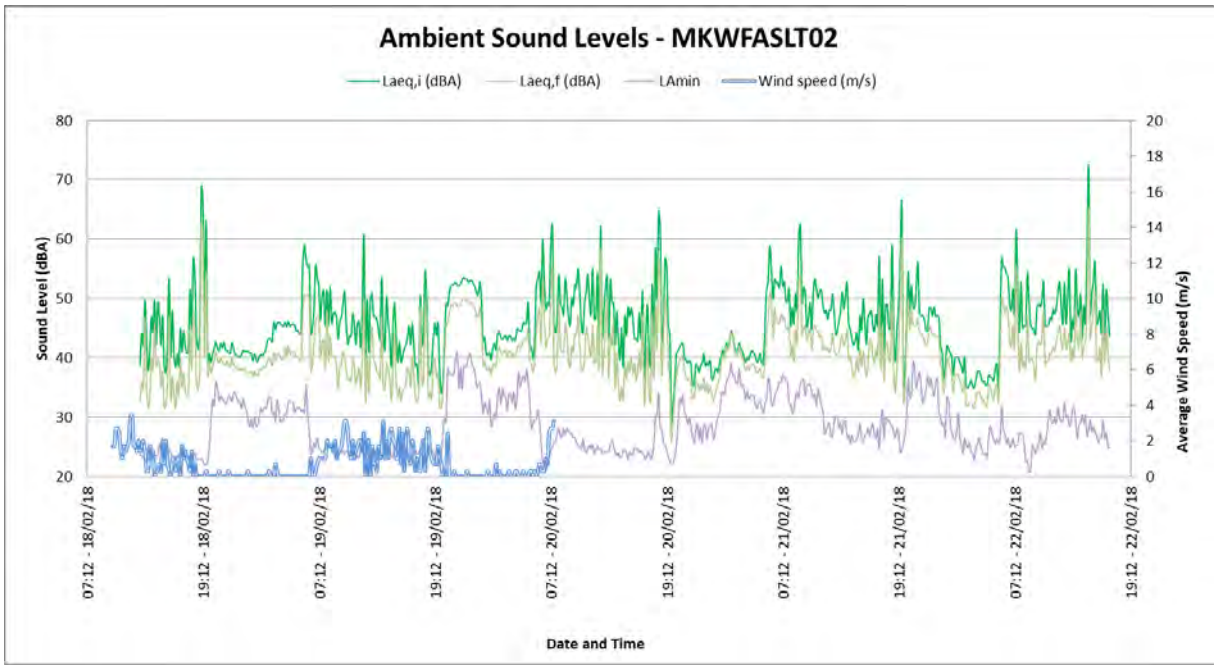

Figure 3-8: Ambient Sound Levels at MKWFASLT02

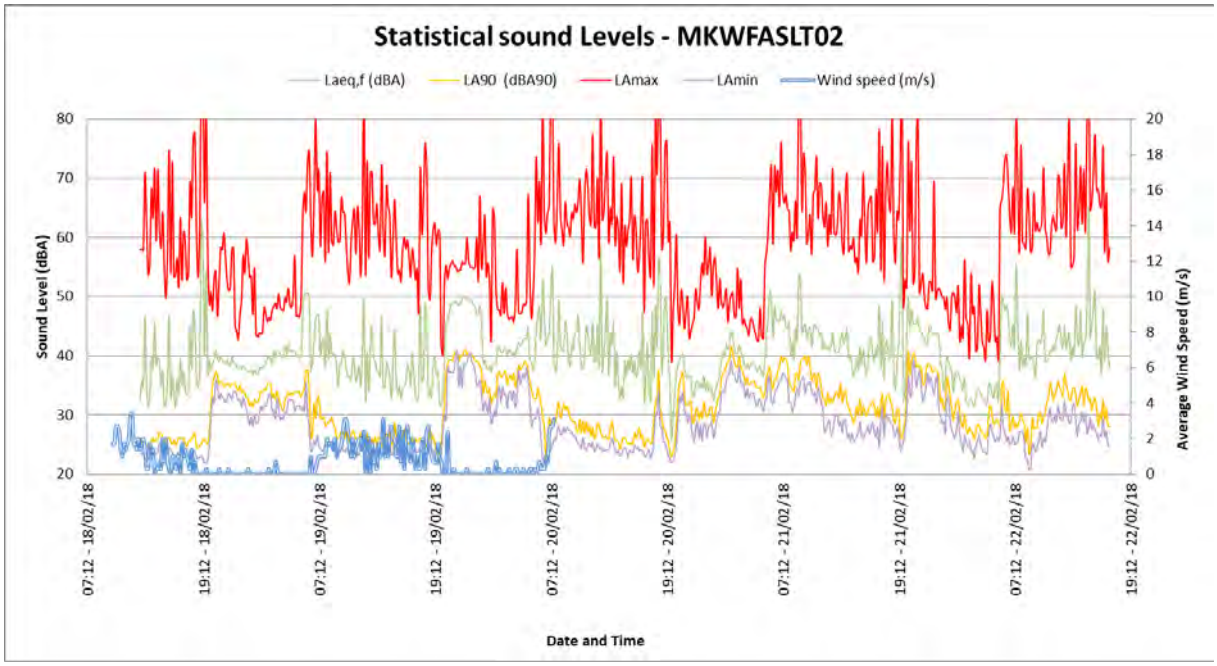

Figure 3-9: Maximum, minimum and statistical values at MKWFASLT02

Third octaves were measured and are displayed in the following Figures. Wind-induced noises had a significant impact on the data for the first day, night and most of the second day (the relatively smooth curves).

Lower frequency (20 – 250 Hz) – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relative smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic

bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies.
Night-time data indicated a site with little acoustic energy in this frequency range (average of approximately 14 dBA) with a peak at 50 Hz (likely an Eskom transformer).
Daytime data shows some acoustic energy in this frequency band, with noises from various sources. Some measurements show a peak at 50 Hz during quiet periods (average of approximately 22 dBA).

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz; mostly below 1,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally features in 630 – 1,600 Hz range.
Night-time data indicate a site with little acoustic energy in this frequency range (average of approximately 25 dBA).
Daytime data shows some acoustic energy in this frequency band. Most measurements indicate sounds from various different sources with numerous measurements indicated a smooth curve indicating wind-induced noises (average acoustic energy of approximately 36 dBA).

Higher frequency (2,000 Hz upwards) – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt etc. There were significant peaks in the 3 150 – 6 300 frequency bands both night and day, likely from birds and insects.
Night-time data indicate significant acoustic energy in this frequency range (average of approximately 39 dBA).
Daytime data indicate significant acoustic energy in this frequency band (average of approximately 39 dBA).

Compliance with international guidelines: Night-time sound levels are elevated and higher than the sound levels typical of a rural area, mainly due to natural sounds. Considering the developmental character of the area, the acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008.

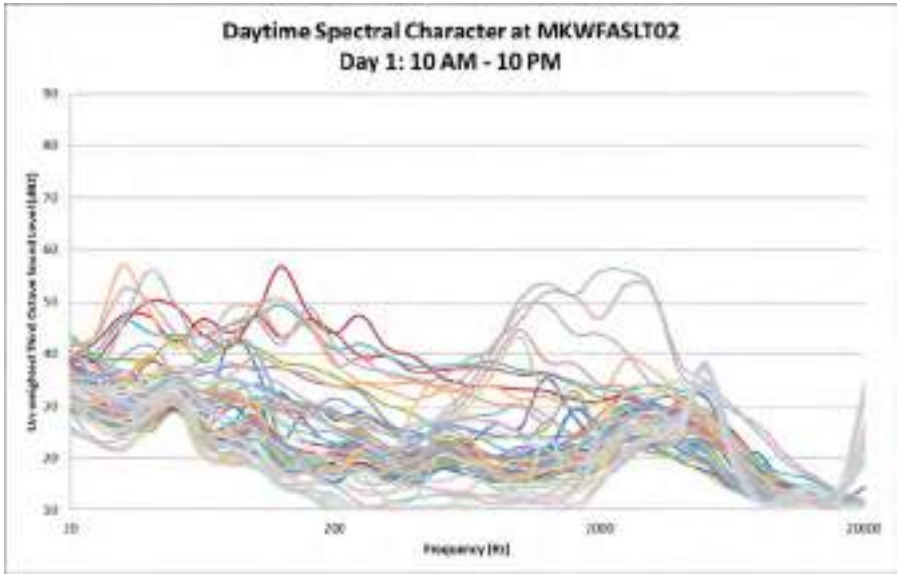

Figure 3-10: Spectral frequencies – MKWFASLT02, Day 1

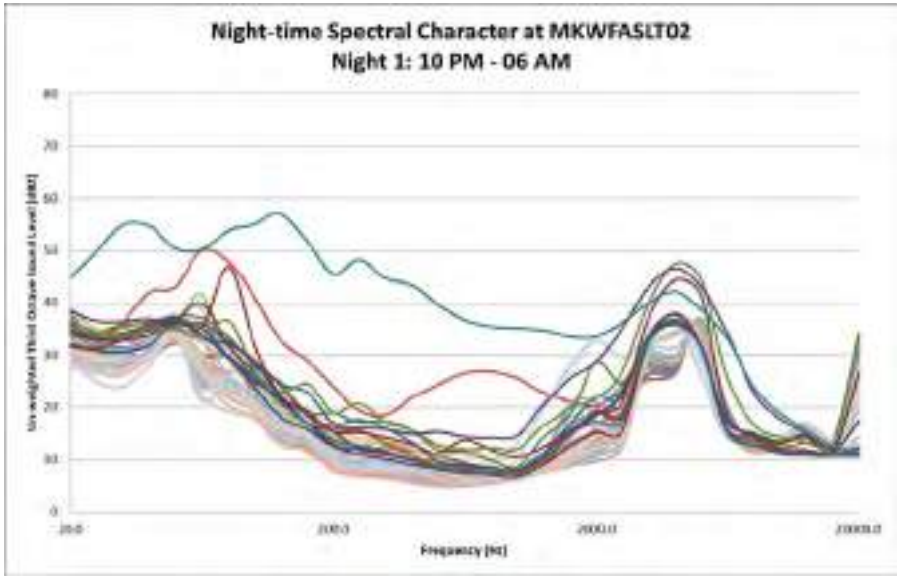

Figure 3-11: Spectral frequencies – MKWFASLT02, Night 1

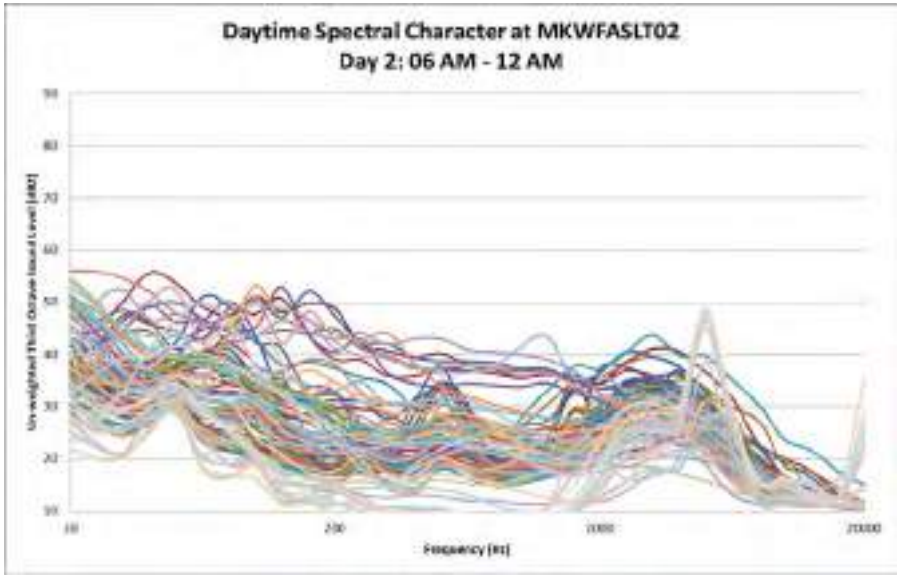

Figure 3-12: Spectral frequencies – MKWFASLT02, Day 2

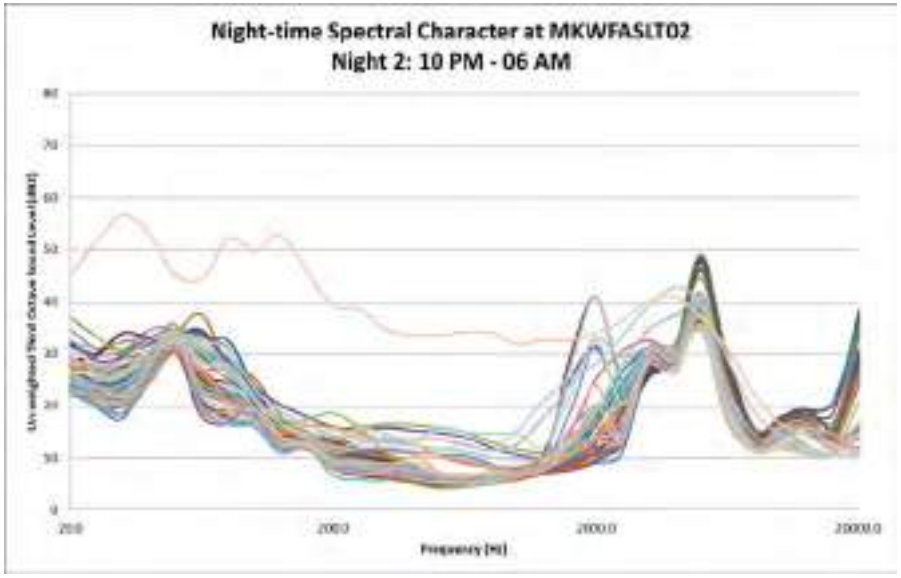

Figure 3-13: Spectral frequencies – MKWFASLT02, Night 2

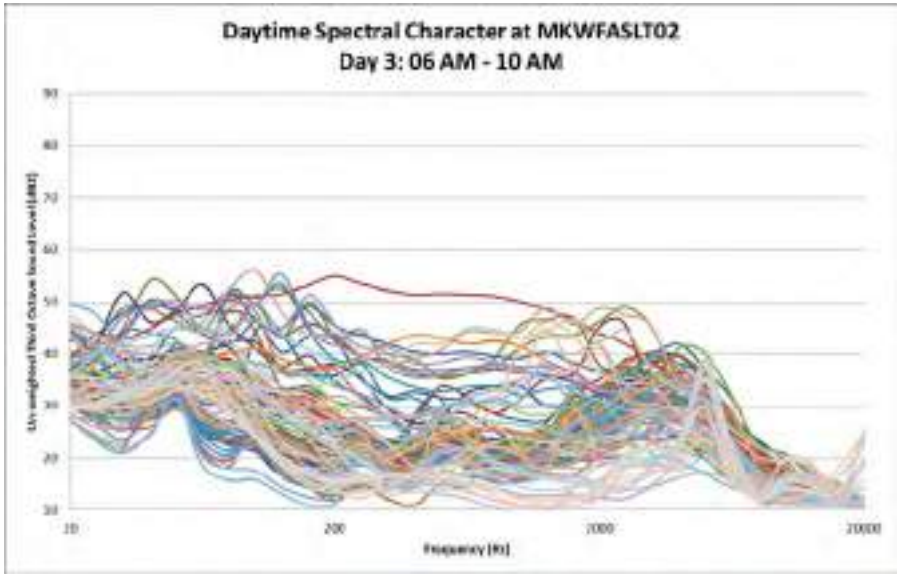

Figure 3-14: Spectral frequencies – MKWFASLT02, Day 3

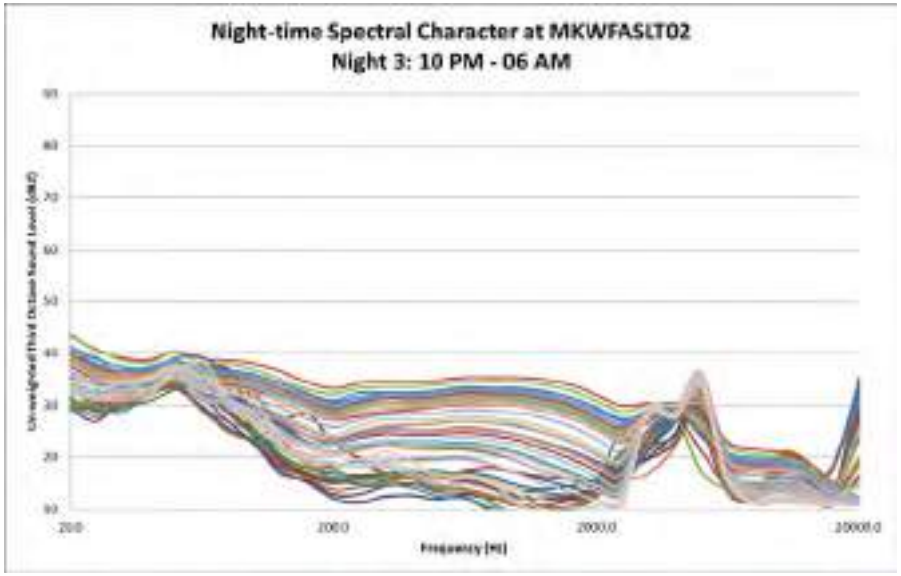

Figure 3-15: Spectral frequencies – MKWFASLT02, Night 3

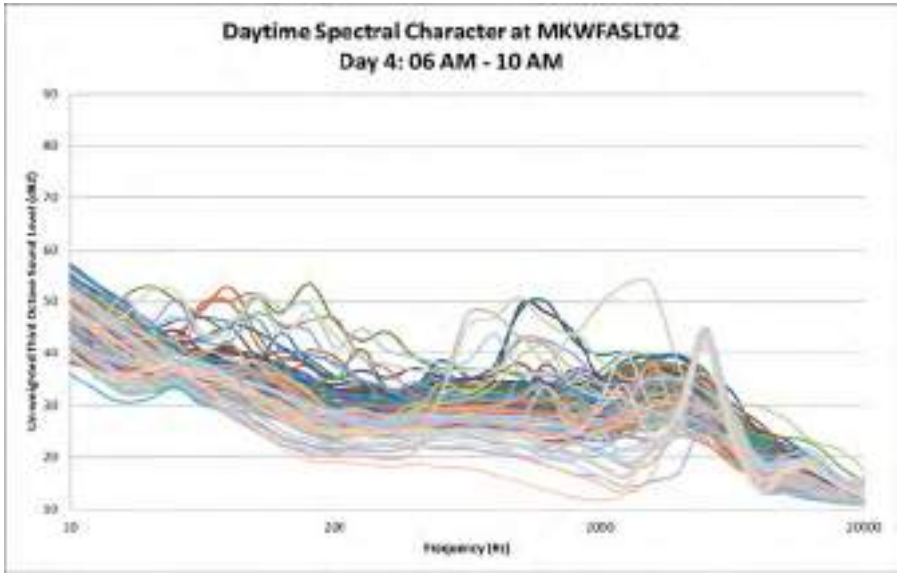

Figure 3-16: Spectral frequencies – MKWFASLT02, Day 4

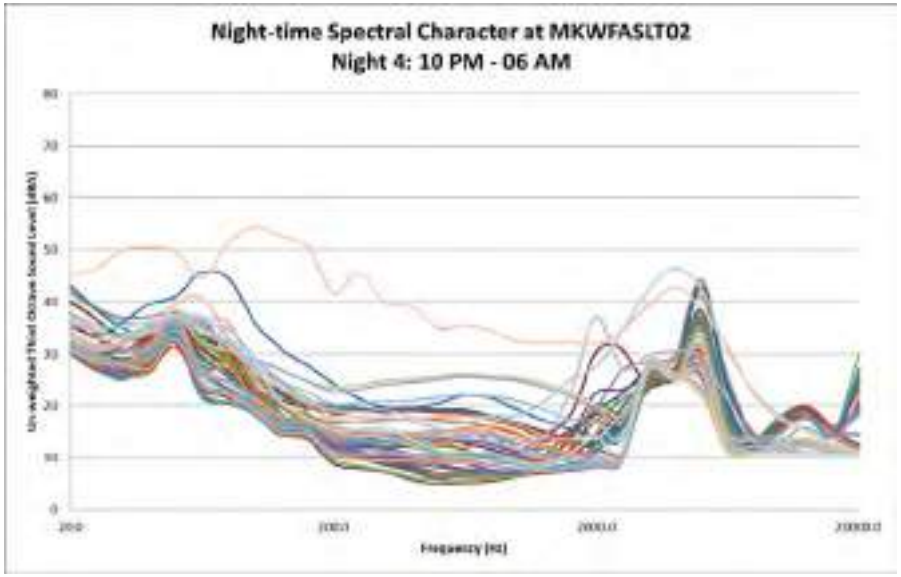

Figure 3-17: Spectral frequencies – MKWFASLT02, Night 4

3.3.3 Measurement Point MKWFASLT03

The equipment defined in **Table 3-7** was used for gathering data. Measured sound levels are presented in **Figure 3-18** and on **Figure 3-19** and defined in **Table 3-9**.

Table 3-7: Equipment used to measure sound levels at MKWFASLT03

Equipment	Model	Serial no	Calibration Date
SLM	Svan 977	34160	February 2017
Microphone	ACO Pacific 7052E	54645	February 2017
Calibrator	Quest CA-22	J 2080094	June 2017

The SLM was erected in a relatively open area in front of the house. Refer to Appendix B for photos of this measurement location. There were a number of large trees close to the house with wind induced sounds clearly audible during increased winds. The dominant noise was from the chickens with the coups located around 50m from the microphone. Sounds heard during the period the instrument was deployed and collected (approximately 60 – 80 minutes) are defined in **Table 3-8**.

Table 3-8: Noises/sounds heard during site visits at receptor MKWFASLT03

		During Deployment	During Collection
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating or clearly audible**	**Faunal and natural**	Bird calls clearly audible. Wind-induced noises at times. Insects audible.	Bird calls clearly audible. Wind-induced noises at times.
	Residential	Voices at times.	-
	Industrial & transportation	Chickens from coup.	Chickens from coup.

Impulse equivalent sound levels (South African legislation): Figure 3-18 illustrates how the impulse-weighted 10-minute equivalent values changes over time with **Table 3-9** defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown on **Figure 3-18** with **Table 3-9** defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound

level. L_{A90} is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time on **Figure 3-19** and defined in **Table 3-9**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Table 3-9** and illustrated in **Figure 3-19**.

Table 3-9: Sound levels considering various sound level descriptors at MKWFASLT03

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	56	52	43	-	-
Night arithmetic average	-	60	53	41	-	-
Day minimum	-	47	43	-	33	-
Day maximum	97	77	73	-	-	-
Night minimum	-	44	41	-	32	-
Night maximum	99	77	68	-	-	-
Day 1 equivalent	-	68	61	-	-	Evening only
Night 1 Equivalent	-	66	57	-	-	8 hour night equivalent average
Day 2 equivalent	-	61	56	-	-	16 hour day equivalent average
Night 2 Equivalent	-	67	58	-	-	8 hour night equivalent average
Day 3 equivalent	-	55	48	-	-	Early morning only

Third octaves were not measured at this location.

Compliance with international guidelines: Day- and night-time ambient sound levels are significantly elevated and higher than the sound levels typical of a rural area, mainly due to the sounds of the chickens in the area. Considering the developmental character of the area, the proximity of the chicken coups, the acceptable zone rating level would be typical of an urban noise district (45 dBA at night and 55 dBA during the day) as defined in SANS 10103:2008.

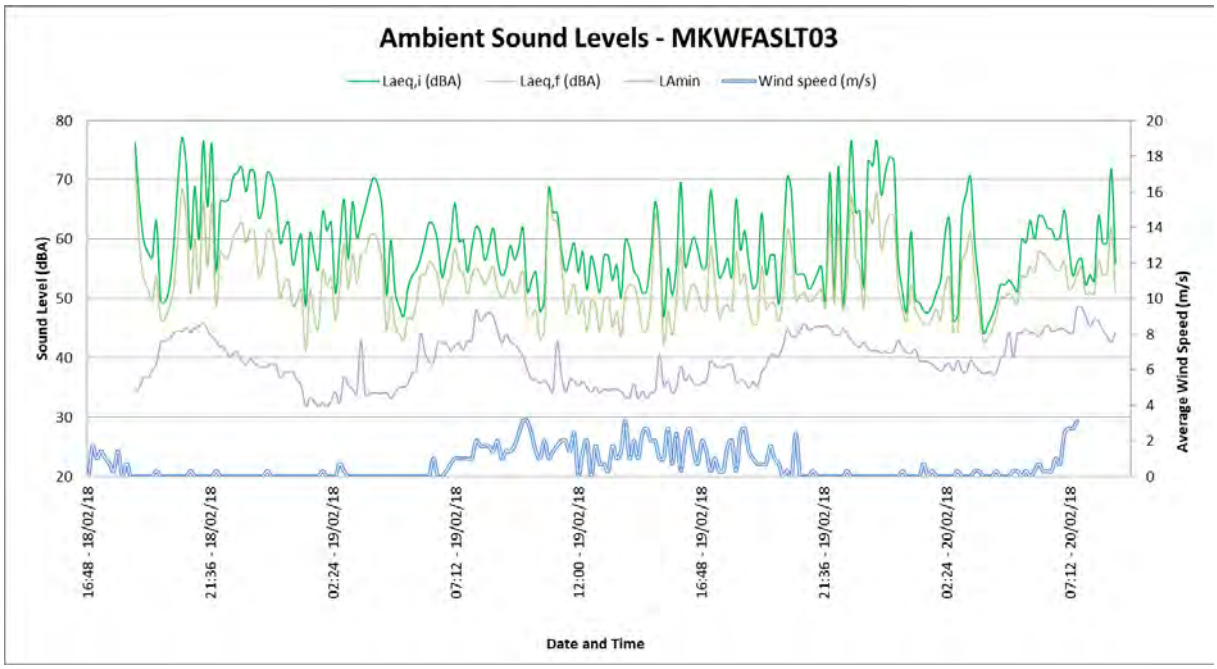

Figure 3-18: Ambient Sound Levels at MKWFASLT03

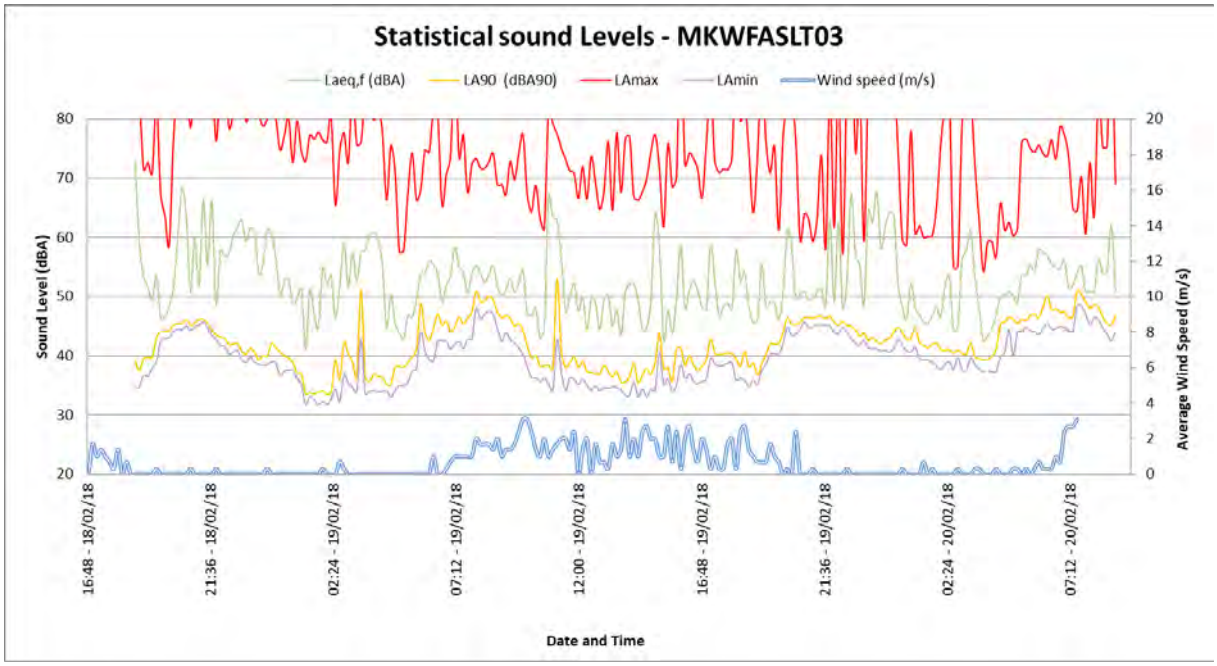

Figure 3-19: Maximum, minimum and statistical values at MKWFASLT03

3.3.4 Measurement Point MKWFASLT04

The equipment defined in **Table 3-10** was used for gathering data. Measured sound levels are presented in **Figure 3-20** and **Figure 3-21** and defined in **Table 3-12**.

Table 3-10: Equipment used to measure sound levels at MKWFASLT04

Equipment	Model	Serial no	Calibration Date
SLM	Svan 955	27637	October 2016
Microphone	ACO Pacific 7052E	52437	October 2016
Calibrator	Quest CA-22	J 2080094	June 2017

The SLM was erected in front of the house. There were a number of large trees and wind induced sounds would be clearly audible during increased winds. Sounds heard during the period the instrument was deployed and collected (approximately 60 – 80 minutes) are defined in **Table 3-11**.

Table 3-11: Noises/sounds heard during site visits at receptor MKWFASLT04

		During Deployment	During Collection
Magnitude Scale Code: • **Barely Audible** • **Audible** • **Dominating or clearly audible**	**Faunal and natural**	Insects audible. Bird calls. Wind-induced noises at times.	Insects audible. Bird communication.
	Residential	Dogs barking.	Dogs barking.
	Industrial & transportation	-	-

Impulse equivalent sound levels (South African legislation): Figure 3-20 illustrates how the impulse-weighted 10-minute equivalent values changes over time with **Table 3-12** defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown on **Figure 3-20** with **Table 3-12** defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. L_{A90} is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The

instrument is set to fast time-weighting. It is illustrated against time on **Figure 3-21** and defined in **Table 3-12**.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in **Table 3-12** and illustrated in **Figure 3-21**.

Table 3-12: Sound levels considering various sound level descriptors at MKWFASLT04

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	50	44	33	-	-
Night arithmetic average	-	53	49	37	-	-
Day minimum	-	33	30	-	21	-
Day maximum	89	75	67	-	-	-
Night minimum	-	36	31	-	25	-
Night maximum	87	76	67	-	-	-
Day 1 equivalent	-	48	40	-	-	Evening only
Night 1 Equivalent	-	44	40	-	-	8 hour night equivalent average
Day 2 equivalent	-	61	53	-	-	16 hour day equivalent average
Night 2 Equivalent	-	62	55	-	-	8 hour night equivalent average
Day 3 equivalent	-	56	49	-	-	16 hour day equivalent average
Night 3 Equivalent	-	61	57	-	-	8 hour night equivalent average
Day 4 equivalent	-	56	51	-	-	16 hour day equivalent average
Night 4 Equivalent	-	62	58	-	-	8 hour night equivalent average
Day 5 equivalent	-	53	46	-	-	Daytime

The instrument was deployed late in the evening and crickets were the dominant sound during the deployment. Some nocturnal bird sounds were audible and it is likely that bird sounds would be dominant during the day (confirmed during collection). There were an Eskom transformer close to the house (around 25m) but it was not audible. There were Jack Russel dogs in the area and they barked quite a bit with movement. There were significant wind-induced noises the last few days.

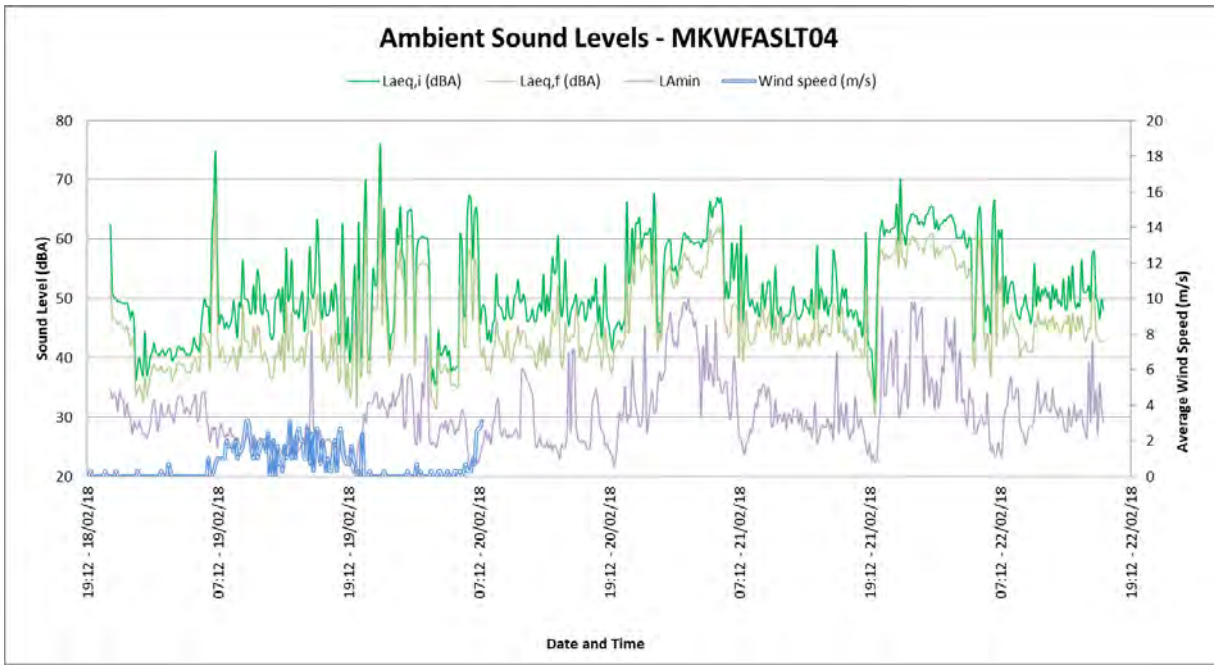

Figure 3-20: Ambient Sound Levels at MKWFASLT04

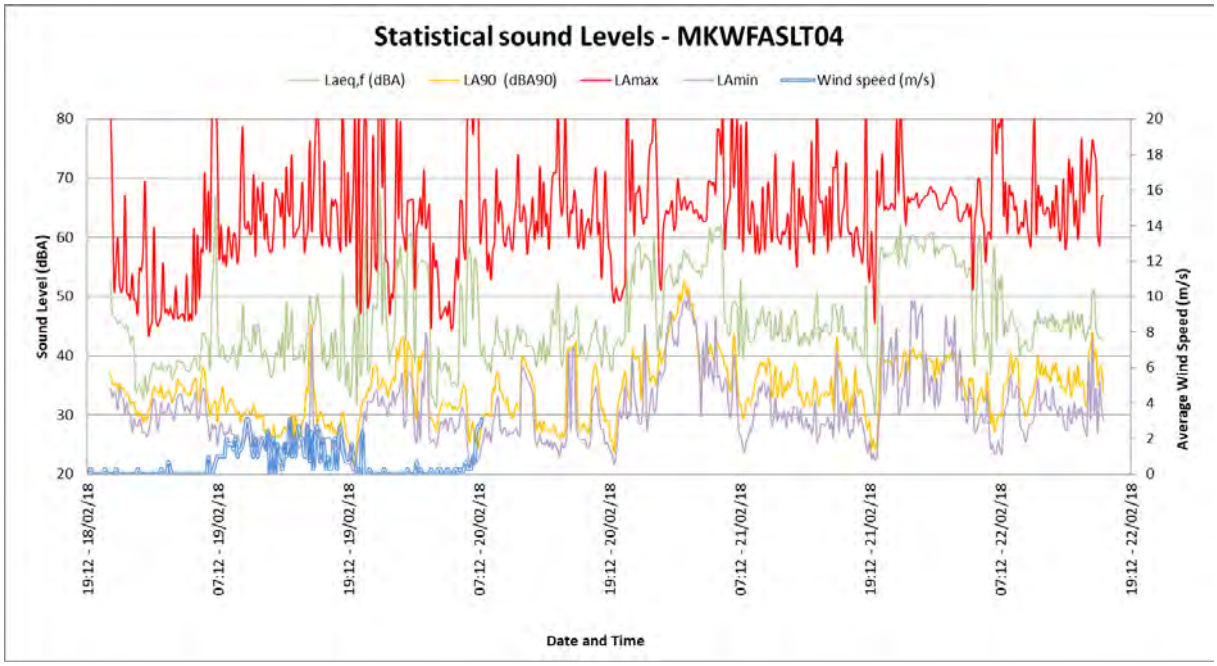

Figure 3-21: Maximum, minimum and statistical values at MKWFASLT04

Third octaves were measured and are displayed in the following Figures. Data showed a wind-induced noises during day 3, 4 and 5 as well as night 3 and 4 (the relatively smooth curves).

Lower frequency (20 – 250 Hz) – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relative smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic

bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies.
Night-time data indicated a site with little acoustic energy in this frequency range (average of approximately 14 dBA – slight peak at 50 Hz during quiet periods, likely an Eskom transformer).
Daytime data shows some acoustic energy in this frequency band, with a few measurements indicating noises from various sources (average of approximately 21 dBA).

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz; mostly below 1,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally features in 630 – 1,600 Hz range.
Night-time data indicate a site with little acoustic energy in this frequency range (average of approximately 28 dBA).
Daytime data shows some acoustic energy in this frequency band. Most measurements indicate sounds from various different sources with numerous measurements indicated a smooth curve indicating wind-induced noises (average acoustic energy of approximately 37 dBA).

Higher frequency (2,000 Hz upwards) – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt etc. There were significant peaks in the 3 150 – 6 300 frequency bands both night and day, likely from birds and insects.
Night-time data indicate significant acoustic energy in this frequency range (average of approximately 48 dBA).
Daytime data indicate significant acoustic energy in this frequency band (average of approximately 42 dBA).

Compliance with international guidelines: Night-time sound levels are elevated and higher than the sound levels typical of a rural area, mainly due to natural sounds. Considering the developmental character of the area, the acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008.

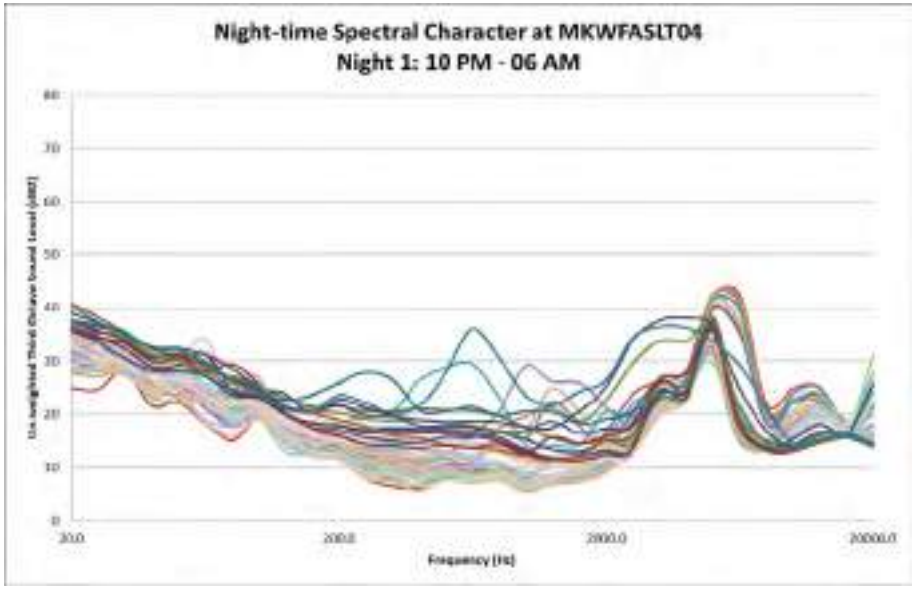

Figure 3-22: Spectral frequencies – MKWFASLT04, Night 1

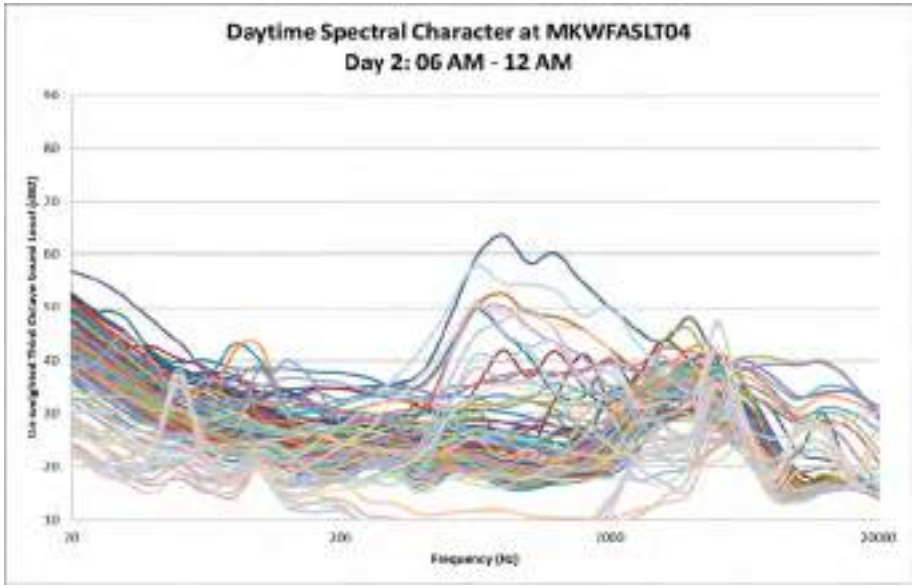

Figure 3-23: Spectral frequencies – MKWFASLT04, Day 2

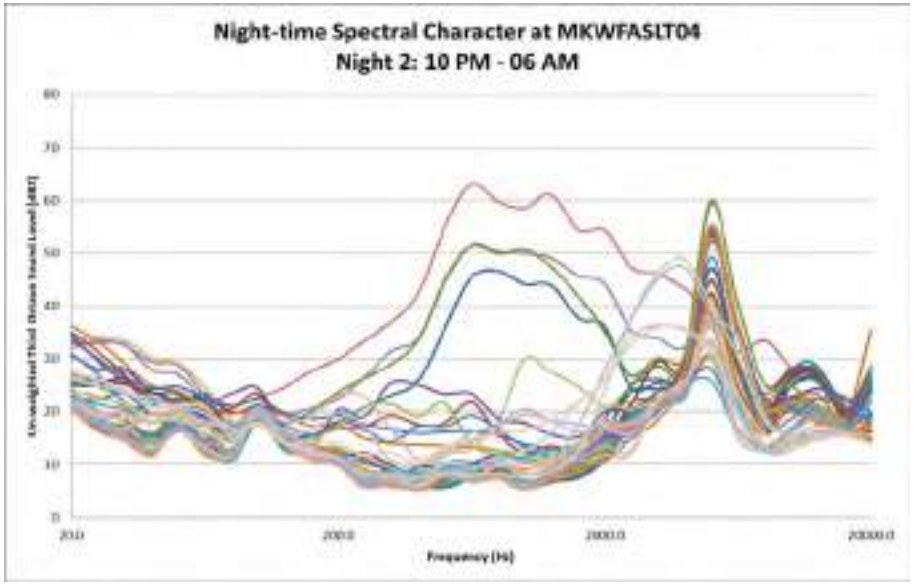

Figure 3-24: Spectral frequencies – MKWFASLT04, Night 2

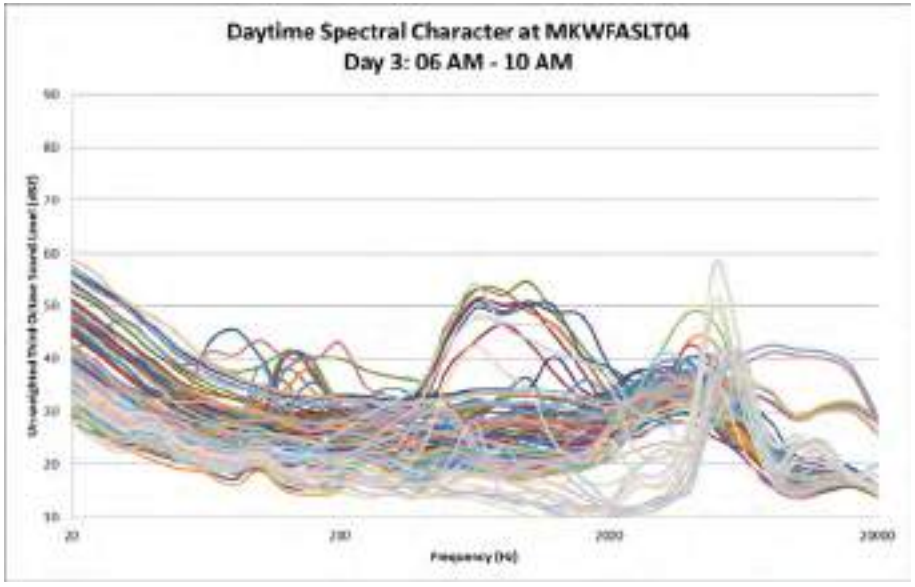

Figure 3-25: Spectral frequencies – MKWFASLT04, Day 3

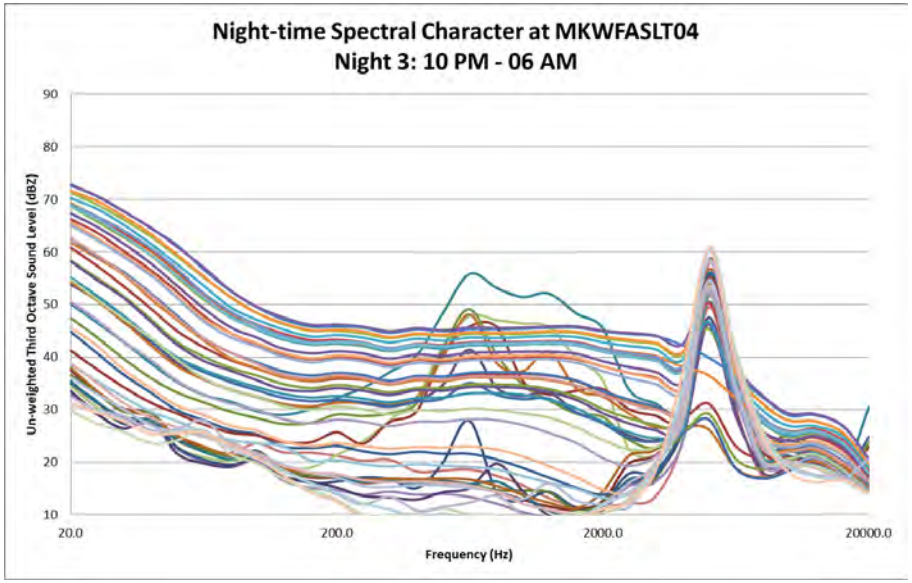

Figure 3-26: Spectral frequencies – MKWFASLT04, Night 3

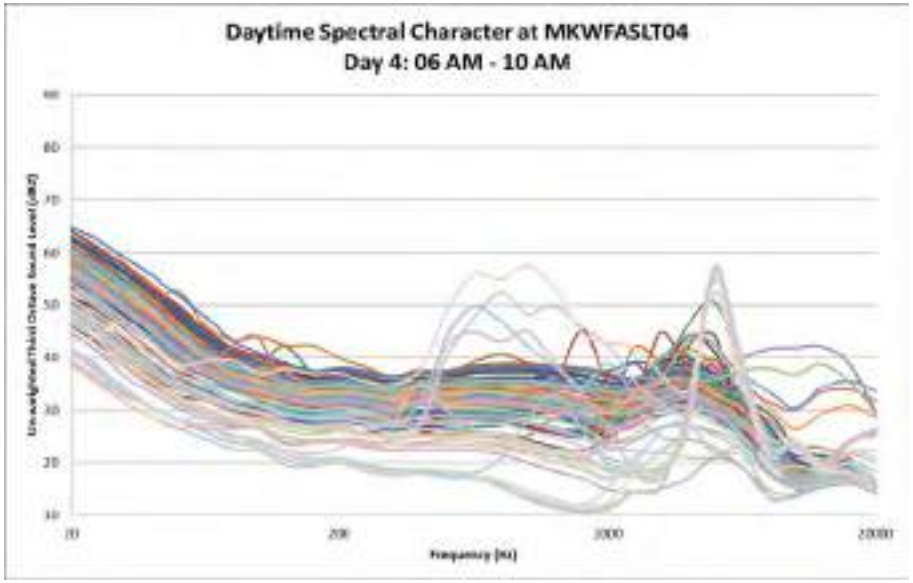

Figure 3-27: Spectral frequencies – MKWFASLT04, Day 4

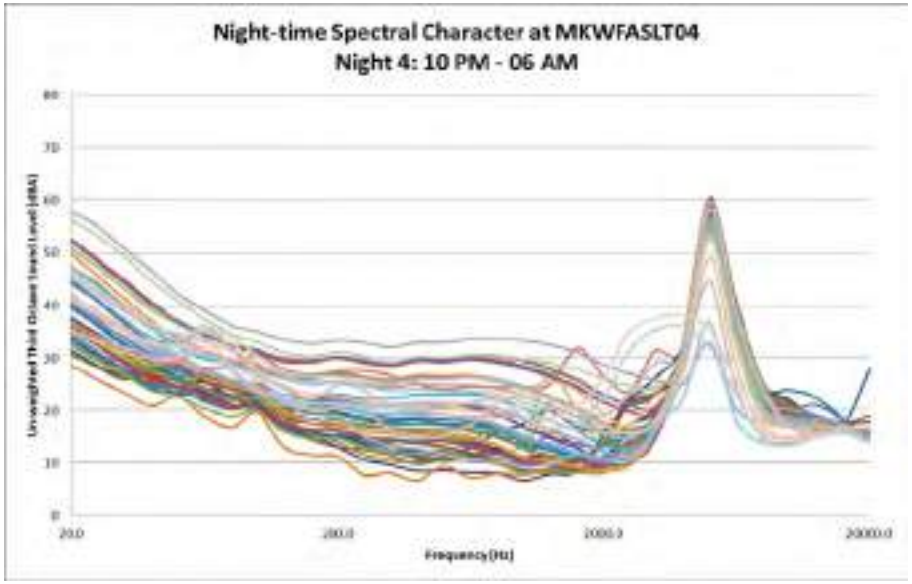

Figure 3-28: Spectral frequencies – MKWFASLT04, Night 4

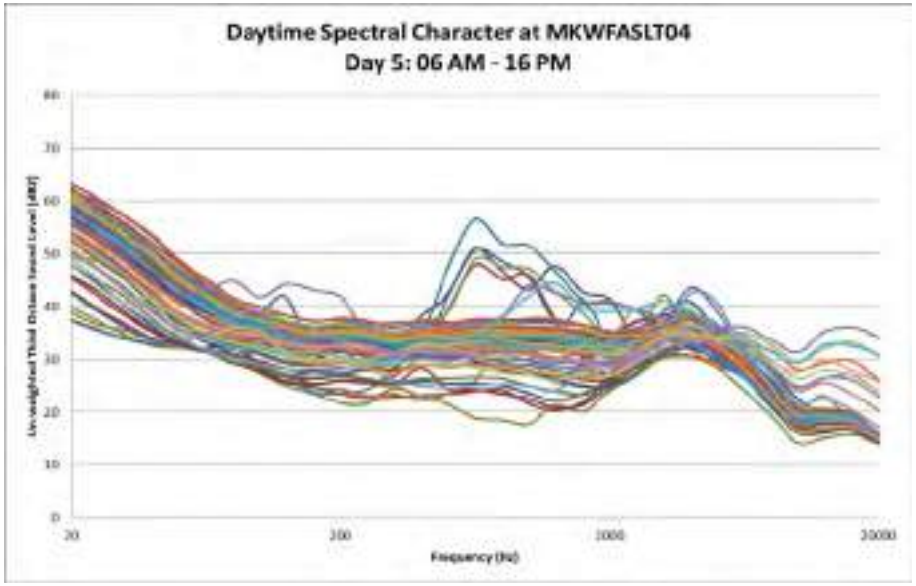

Figure 3-29: Spectral frequencies – MKWFASLT04, Day 5

4 POTENTIAL NOISE SOURCES

Increased noise levels are directly linked with the various activities associated with the construction of the WF and related infrastructure, as well as the operation phase of the activity. The specific activities relating to construction of the WF will only be known during the EIA phase once a layout is available for review. It will only be discussed in a generalised manner in the following sections.

However, commonly the most significant stage relating to noise is the operation phase, and not the construction phase. This is because the duration of activities during the construction phase are generally short.

4.1 POTENTIAL NOISE SOURCES: CONSTRUCTION PHASE

4.1.1 Construction equipment

There are a number of factors that determine the audibility as well as the potential of a noise impact on receptors. Maximum noises generated can be audible over a large distance, however, are generally of very short duration. If maximum noise levels however exceed 65 dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15 dB, the noise can increase annoyance levels and may ultimately result in noise complaints. Potential maximum noise levels generated by various construction equipment as well as the potential extent of these sounds are presented in **Table 4.1**.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical sound power levels associated with various activities that may be found at a construction site is presented in **Table 4.2**.

Table 4.1: Potential maximum noise levels generated by construction equipment

Equipment Description[4]	Impact Device?	Maximum Sound Power Levels (dBA)	Operational Noise Level at given distance considering potential maximum noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modeling only considering distance) (dBA)											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Auger Drill Rig	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Backhoe	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Chain Saw	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Compactor (ground)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Concrete Saw	No	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Jackhammer	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Mounted Impact Hammer	Yes	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Roller	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibratory Concrete Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Vibratory Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6

[4] Equipment list and Sound Power Level source: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

Table 4.2: Potential equivalent noise levels generated by various equipment

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Air compressor	92.6	67.6	61.6	55.5	47.6	41.6	38.0	35.5	32.0	27.6	24.1	21.6	15.5
Bulldozer CAT D10	111.9	86.9	80.9	74.9	66.9	60.9	57.4	54.9	51.3	46.9	43.4	40.9	34.9
Cement truck (with cement)	111.7	86.7	80.7	74.7	66.7	60.7	57.2	54.7	51.2	46.7	43.2	40.7	34.7
Crane	107.5	82.5	76.5	70.5	62.5	56.5	53.0	50.5	46.9	42.5	39.0	36.5	30.5
Diesel Generator (Large - mobile)	106.1	81.2	75.1	69.1	61.2	55.1	51.6	49.1	45.6	41.2	37.6	35.1	29.1
Dumper/Haul truck - Terex 30 ton	112.2	87.2	81.2	75.2	67.2	61.2	57.7	55.2	51.7	47.2	43.7	41.2	35.2
Excavator - Hitachi EX1200	113.1	88.1	82.1	76.1	68.1	62.1	58.6	56.1	52.6	48.1	44.6	42.1	36.1
FEL (988) (FM)	115.6	90.7	84.6	78.6	70.7	64.6	61.1	58.6	55.1	50.7	47.1	44.6	38.6
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
Road Truck average	109.6	84.7	78.7	72.6	64.7	58.7	55.1	52.6	49.1	44.7	41.1	38.7	32.6
Rock Breaker, CAT	120.7	95.7	89.7	83.7	75.7	69.7	66.2	63.7	60.2	55.7	52.2	49.7	43.7
Vibrating roller	106.3	81.3	75.3	69.3	61.3	55.3	51.8	49.3	45.8	41.3	37.8	35.3	29.3
Water Dozer, CAT	113.8	88.8	82.8	76.8	68.8	62.8	59.3	56.8	53.3	48.8	45.3	42.8	36.8
Wind Turbine: Acciona AW125/3000	108.4	85.4	79.4	73.4	65.4	59.4	55.9	53.4	49.9	45.4	41.9	39.4	33.4
Wind Turbine: Vesta V66, ave	102.6	77.7	71.6	65.6	57.7	51.6	48.1	45.6	42.1	37.7	34.1	31.6	25.6
Wind Turbine: Vesta V66, max	108.0	83.0	77.0	71.0	63.0	57.0	53.5	51.0	47.5	43.0	39.5	37.0	31.0
Wind Turbine: Vesta V66, min	96.3	71.3	65.3	59.3	51.3	45.3	41.8	39.3	35.8	31.3	27.8	25.3	19.3
Wind Turbine: Vestas V117 3.3MW	107.0	82.0	76.0	70.0	62.0	56.0	52.5	50.0	46.4	42.0	38.5	36.0	30.0

Construction activities include:

- construction of access roads,
- establishment of turbine tower foundations and electrical substation(s),
- the possible establishment, operation and removal of concrete batching plants,
- the construction of any buildings,
- digging of trenches to accommodate underground power cables; and
- the erection of turbine towers and assembly of WTGs.

The equipment likely to be required to complete the above tasks will typically include:

- excavator/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flatbed truck(s), pile drivers, TLB, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.

4.1.2 Material supply: Concrete batching plants and use of Borrow Pits

Instead of transporting the required material to the site using concrete trucks, portable concrete batching plants may be required to supply concrete on site. Batching plant equipment may be relocated between the sites as the works progress to different areas of the site. The need for such batching plants, the number, and whether they will be moved is unknown at this stage.

Similarly, the need and potential location(s) for a borrow pit are unknown. A portable rock crusher plant and screen will most likely be required if the developer selects the use of a borrow pit.

4.1.3 Blasting

Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. Should a borrow pit be used to supply rocks for construction purposes, blasting could also be expected. However, no information regarding the use, or even the feasibility of such a borrow pit is known.

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 minimum explosives and will occur in a controlled manner. With regards to blasting in borrow pits, explosives are used with a low detonation speed, reducing vibration, sound pressure levels and air blasts. The breaking of obstacles with explosives is also a specialized field, and when correct techniques are used, it causes 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.
- Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relative fast, resulting in a higher acceptance of the noise.

4.1.4 Traffic

The last significant source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. The use of a borrow pit(s), on site crushing and screening and concrete batching plants will significantly reduce heavy vehicle movement to and from the site.

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 traffic will be estimated using the methodology stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise).

4.2 POTENTIAL NOISE SOURCES: OPERATION PHASE

Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources which 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 normally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the sub-stations, traffic (maintenance) and transmission line noise.

4.2.1 Wind Turbine Noise: Aerodynamic sources[5]

Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:

1. Self-noise due to the interaction of the turbulent boundary layer with the blade trailing edge.
2. Noise due to inflow turbulence (turbulence in the wind interacting with the blades).
3. Discrete frequency noise due to trailing edge thickness.
4. Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade).

[5] *Renewable Energy Research Laboratory, 2006; ETSU R97: 1996*

5. Noise generated by the rotor tips.

Therefore, as the wind speed increases, noises created by the wind turbine also increases. At a low wind speed the noise created by the wind turbine is generally (relatively) low, and increases to a maximum at a certain wind speed when it either remains constant, increase very slightly or even drops as illustrated in **Figure 4-1**.

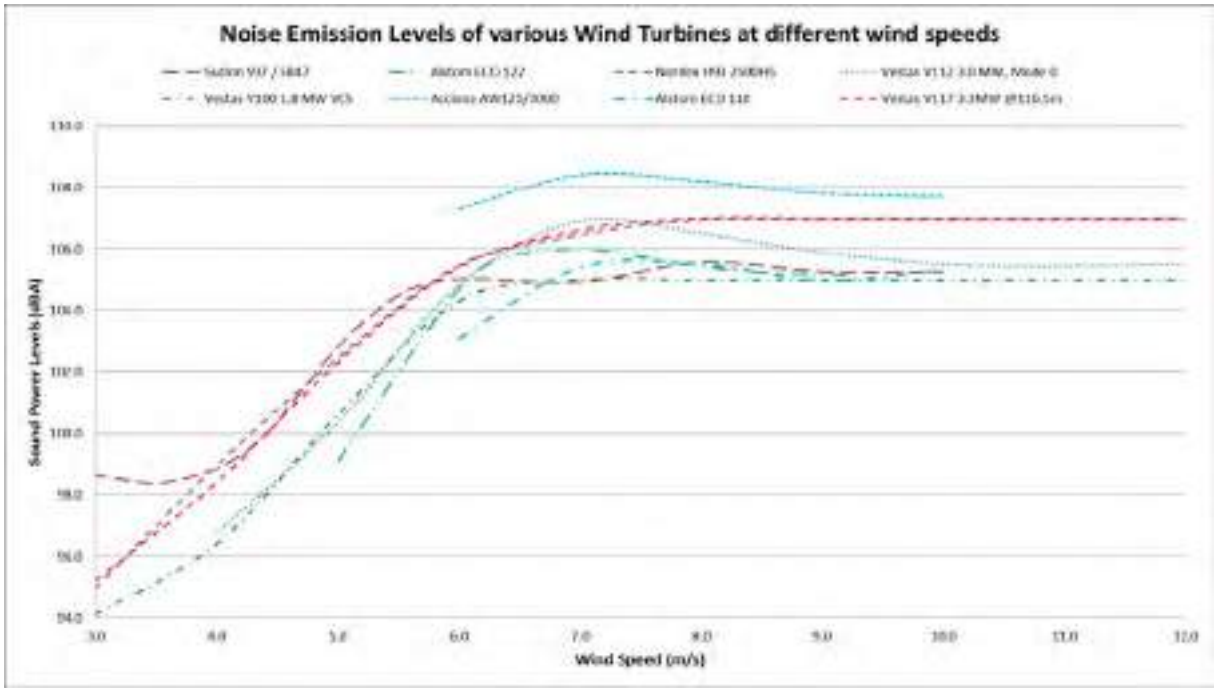

Figure 4-1: Noise Emissions Curve of a number of different wind turbines (figure for illustration purposes only)

4.2.2 Wind Turbine: Mechanical sources[6]

Mechanical noise is normally perceived within the emitted noise from wind turbines as an audible tone(s) which is subjectively more intrusive than a broad band noise of the same sound pressure level. Sources for this noise are normally associated with:

- the gearbox and the tooth mesh frequencies of the step up stages;
- generator noise caused by coil flexure of the generator windings which is associated with power regulation and control;
- generator noise caused by cooling fans; and
- control equipment noise caused by hydraulic compressors for pitch regulation and yaw control.

[6] *Renewable Energy Research Laboratory, 2006; ETSU R97: 1996; Audiology Today, 2010; HGC Engineering, 2007*

Tones are noises with a narrow sound frequency composition (e.g. the whine of an electrical motor). Annoying tones can be created in numerous ways: machinery with rotating parts such as motors, gearboxes, fans and pumps often create tones. An imbalance or repeated impacts may cause vibration that, when transmitted through surfaces into the air, can be heard as tones. Pulsating flows of liquids or gases can also create tones, which may be caused by combustion processes or flow restrictions. The best and most well-known example of a tonal noise is the buzz created by a flying mosquito.

Where complaints have been received due to the operation of wind farms, tonal noise from the installed wind turbines appears to have increased the annoyance perceived by the complainants and has indeed been the primary cause for complaint.

However, tones were normally associated with the older models of turbines. All turbine manufacturers have started to ensure that sufficient forethought is given to the design of quieter gearboxes and the means by which these vibration transmission paths may be broken. Through the use of careful gearbox design and/or the use of anti-vibration techniques, it is possible to minimize the transmission of vibration energy into the turbine supporting structure. The benefits of these design improvements have started to filter through into wind farm developments which are using these modified wind turbines. ***New generation wind turbine generators do not emit any clearly distinguishable tones***.

4.2.3 Transformer noises (Sub-stations)

Also known as magnetostriction, is when the sheet steel used in the core of the transformer tries to change shape when being magnetized. When the magnetism is taken away, the shape returns, only to try and deform in a different manner when the polarity is changed.

This deformation is not uniform; consequently it varies all over a sheet. With a transformer core being composed of many sheets of steel, these deformations is taking place erratically all over each sheet, and each sheet is behaving erratically with respect to its neighbour. The resultant is the “hum” frequently associated with transformers. While this may be a soothing sound in small home appliances, various complaints are logged in areas where people stay close to these transformers. At a voltage frequency of 50 Hz, these “vibrations” take place 100 times a second, resulting in a tonal noise at 100Hz. ***However, this is a relative easy noise to mitigate with the use of acoustic shielding and/or placement of the transformer and will not be considered further in this noise scoping report or ENIA study.***

4.2.4 Transmission Line Noise (Corona noise)

Corona noise is caused by the partial breakdown of the insulation properties of air surrounding the conducting wires. It can generate an audible and radio-frequency noise, but generally only occurs in humid conditions, as provided by fog or rain. A minimum line potential of 70kV or higher is generally required to generate corona noise depending on the electrical design. Corona noise does not occur on domestic distribution lines.

Corona noise has two major components: a low frequency tone associated with the frequency of the AC supply (100 Hz for 50 Hz source) and broadband noise. The tonal component of the noise is related to the point along the electric waveform at which the air begins to conduct. This varies with each cycle and consequently the frequency of the emitted tone is subject to great fluctuations. Corona noise can be characterised as broadband 'crackling' or 'buzzing', but ***fortunately it is generally only a feature during fog or rain***.

It will not be further investigated, as corona discharges results in:

- Power losses,
- Audible noises,
- Electromagnetic interference,
- A purple glow,
- Ozone production; and
- Insulation damage.

As such Electrical Service Providers, such as ESKOM, go to great lengths to design power transmission equipment to minimise the formation of corona discharges. In addition, it is an infrequent occurrence with a relatively short duration compared to other operational noises.

4.2.5 Low Frequency Noise[7]

4.2.5.1 Background and Information

Low frequency sound is the term used to describe sound energy in the region below ~200Hz. The rumble of thunder and the throb of a diesel engine are both examples of sounds with most of their energy in this low frequency range. Infrasound is often used to describe sound energy in the region below 20Hz. Almost all noise in the environment has components in this region although they are of such a low level that they are not significant (wind, ocean, thunder).

[7] *Renewable Energy Research Laboratory, 2006; DELTA, 2008; DEFRA, 2003; HGC Engineering, 2006; Whitford, Jacques, 2008; Noise-con, 2008; Minnesota DoH, 2009; Kamperman, 2008, Van den Berg, 2004*

While significant work has been done on this field, there exist uncertainties around Infrasound and Low Frequency Noise.

4.2.5.2 The generation of Low Frequency Sounds

Because of the low rotational rates of the blades of a WTG, the peak acoustic energy radiated by large wind turbines is in the infrasonic range with a peak in the 8-12 Hz range. For smaller machines, this peak can extend into the low-frequency "audible" (20-20KHz) range because of higher rotational speeds and multiple blades.

4.2.5.3 Detection of Low Frequency Sounds

Investigations have shown that the perception and the effects of sounds differ considerably at low frequencies as compared to mid- and high frequencies. The main aspects to these differences are:

- a weakening of pitch sensation as the frequency of the sound decreases below 60 Hz;
- perception of sounds as pulsations and fluctuations;
- a much more rapid increase of loudness and annoyance with increasing sound level at low frequencies than at mid- or high frequencies;
- complaints about the feeling of ear pressure;
- annoyance caused by secondary effects like rattling of building elements, e.g. windows and doors or the tinkling of bric-a-brac;
- other psycho acoustic effects, e.g. sleep deprivation, a feeling of uneasiness; and
- reduction in building sound transmission loss at low frequencies compared to mid- or high frequencies.

4.2.5.4 Measurement, Isolation and Assessment of Low Frequency Sounds

There remains significant debate regarding the noise from WTG's, public response to that noise, as well as the presence or not of low frequency sound and how it affects people. While low frequency sounds can be measured, it is far more difficult to isolate low frequency sounds due to the numerous sources generating these sounds.

From sound power level emission tables (for Wind Turbines) it can be seen that a wind turbine has the potential to generate low frequency sounds with sufficient energy to warrant the need to investigate WTG as a source of low frequency sounds. Each turbine make, model and size has a specific noise emission characteristic. The larger a wind turbine (especially the blades), the higher the acoustical energy in the lower frequencies and the potential for low frequency sounds should be evaluated for each project and turbine proposed.

SANS 10103:2004 proposes a method to identify whether low frequency noise could be an issue. It proposes that if the difference between the A-frequency weighted and the C-frequency weighted equivalent continuous (L_{Aeq} >> L_{Ceq}) sound pressure levels is greater than 10 dB, a predominant low frequency component **may** be present.

4.2.5.5 Summary: Low Frequency Noise[8]

Low frequency noise is always present around us as it is produced by both man and nature. While problems have been associated with older downwind wind turbines in the 1980s, this has been considered by the wind industry and modern upwind turbines do not suffer from the same problems.

4.2.6 Amplitude modulation[9]

Although very rare, there is one other characteristic of wind turbine sound that increases the sleep disturbance potential above that of other long-term noise sources. The amplitude modulation of the sound emissions from the wind turbines creates a repetitive rise and fall in sound levels synchronized to the blade rotation speed, sometimes referred to as a “swish” or “thump”.

Regrettably the mechanism of this noise is not known though various possible reasons have been put forward. Although the prevalence of complaints about amplitude modulation is relatively small, it is not clear whether this is because it does not occur often enough or whether it is because housing is not in the right place to observe it. Furthermore the fact that the mechanism is unknown means that it is not possible to predict when or whether it will occur.

Even though there are thousands of wind turbine generators in the world, amplitude modulation is one subject receiving the least complaints and due to this very few complaints, little research has gone into this subject. ***It is included in this report to highlight all potential risks, albeit extremely low risks such as this (low significance due to very low probability)***.

[8] *BWEA, 2005*
[9] *Renewable Energy Research Laboratory, 2006; Audiology Today, 2010; HGC Engineering, 2007; Whitford, 2008; Noise-con, 2008; DEFRA, 2007; Bowdler, 2008*

5 METHODOLOGY: CALCULATION OF FUTURE NOISE EMISSIONS DUE TO PROPOSED PROJECT

5.1 NOISE EMISSIONS INTO THE SURROUNDING ENVIRONMENT

The noise emissions into the environment from the various sources as defined by the project developer will be calculated during the EIA phase using the sound propagation models described by ISO 9613-2 and SANS 10357[10]. The following will be taken into account:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The meteorological conditions in terms Pasquill stability;
- The preliminary layout details of the proposed project;
- The height of the noise source under investigation;
- Topographical layout; and,
- Acoustical characteristics of the ground.

The potential impact from traffic will not be considered during the Scoping phase, but only in the EIA phase. During the EIA phase the noise emission into the environment from the various traffic options will be calculated using the sound propagation model described in SANS 10210[11]. Corrections such as the following will be considered:

- Distance of a noise-sensitive development from roads;
- Road construction material;
- Average speeds of travel;
- Types of vehicles used;
- Ground acoustical conditions.

[10] SANS 10357:2004 The calculation of sound propagation by the Concave method'
[11] SANS 10210:2004. 'Calculating and predicting road traffic noise'

6 ASSUMPTIONS AND LIMITATIONS

6.1 MEASUREMENTS OF AMBIENT SOUND LEVELS

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement. Therefore trying to define ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement.
- Ambient sound levels are depended not only time of day and meteorological conditions, but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise. Many faunal species are more active during warmer periods than colder periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[12];
- Only two measurements were done during 2010 in the vicinity of the proposed development. These measurements indicated an area that is very quiet. Considering the measurements, vegetation, climate, faunal activity as well as the very low developmental character of the area, it is the opinion of the Author that the levels measured is representative of the sound levels in the area; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

[12] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

6.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

The noise emissions into the environment from the various sources, as defined, will be calculated for the operation phase in detail, using the sound propagation model described in SANS 10357:2004.

The following was considered:

- The octave band sound pressure emission levels of defined equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Acoustical characteristics of the ground. Hard ground conditions were modelled.

The noise emission into the environment due to additional traffic will not be considered during this scoping phase but only generalized, due to the limited extent of traffic noises (due to low traffic volumes).

6.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds are also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.

As previously mentioned, it is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor, but to calculate a noise rating level that is used to identify potential issues of concern.

6.4 UNCERTAINTIES OF INFORMATION PROVIDED

While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is difficult to accurately model noise levels at a receptor from any operation. The projected noise levels are the output of a numerical model with the accuracy depending on the assumptions made during the setup of the model. Assumptions include:

- The octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of this processes/equipment. The determination of these levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- Sound power emission levels from processes and equipment change depending on the load, the process and equipment. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load. Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worse-case scenario;
- During the scoping phase it is unknown which processes and equipment will be operational (and when operational and for how long), modelling considers a scenario where all processes and equipment are under full load for a set time period. Modelling assumptions complies with the precautionary principle and operational time periods which are frequently overestimated. The result is that projected noise levels would likely over-estimate noise levels;
- Ambient sound levels vary over time of day, season and largely depend on the complexity and development character of the surrounding environment. To allow the calculation of change in ambient sound levels, a potential ambient sound level of 20 dBA is assumed. This level represents a very quiet environment.
- Modelling cannot capture the potential impulsive or tonal character of a noise that can increase the potential nuisance factor.
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify;
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform.

7 METHODOLOGY: ENVIRONMENTAL NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

7.1 NOISE IMPACT ON ANIMALS[13]

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on animals. While aircraft noise have a specific characteristic, the findings should be relevant to most noise sources.

Overall, the research suggests that species differ in their response to:

- Various types of noise
- Durations of noise
- Sources of noise

A general animal behavioural reaction to aircraft noise is the startle response. However, the strength and length of the startle response appears to be dependent on:

- which species is exposed
- whether there is one animal or a group
- whether there have been some previous exposures

Unfortunately, there are numerous other factors in the environment of animals that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

From these and other studies the following can be concluded:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate. This is not relevant to wind energy facilities because the turbines do not generate any impulsive noises close to these sound levels.
- Animals of most species exhibit adaptation with noise, including aircraft noise and sonic booms (far worse than noises associated with Wind Turbines).
- More sensitive species would relocate to a more quiet area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate.
- Noises associated with helicopters, motor- and quad bikes significantly impact on animals.

[13] Report to Congressional Requesters, 2005; USEPA, 1971; Autumn, 2007; Noise quest, 2010

7.2 WHY NOISE CONCERNS COMMUNITIES[14]

Noise can be defined as "unwanted sound", an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication,
- Impedes the thinking process,
- Interferes with concentration,
- Obstructs activities (work, leisure and sleeping),
- Presents a health risk due to hearing damage.

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears no noise, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:

- Background sound levels, and the background sound levels the receptor is used to,
- The manner in which the receptor can control the noise (helplessness),
- The time, unpredictability, frequency, distribution, duration, and intensity of the noise,
- The physiological state of the receptor,
- The attitude of the receptor about the emitter (noise source).

7.2.1 Annoyance associated with Wind Energy Facilities[15]

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to be the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that non-acoustic factors plays a major role. Non-acoustic factors that have been identified include age,

[14] World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009
[15] Van den Berg, 2011; Milieu, 2010.

economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity.

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in Figure 7-1, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance. This can be used in an Environmental Health Impact Assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into the situation expected in the long term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise climate.

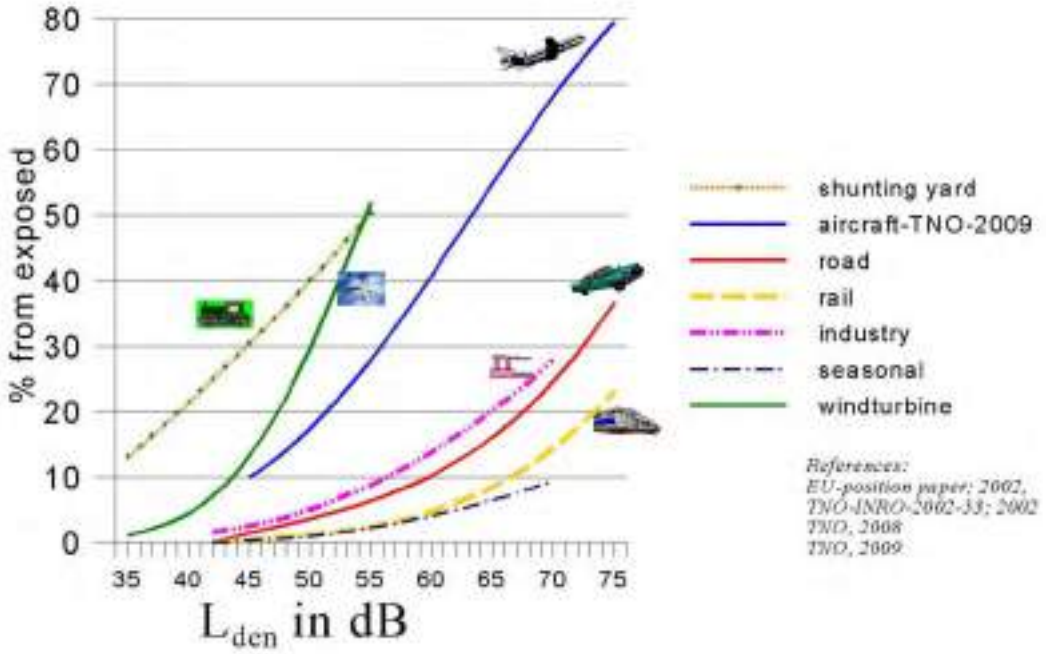

Figure 7-1: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling

7.3 IMPACT ASSESSMENT CRITERIA

7.3.1 Overview: The common characteristics

In the word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity
- Loudness

- Annoyance
- Offensiveness

Of the four common characteristics of sound, intensity is the only one which is not subjective and can be quantified. Loudness is a subjective measure of the effect the sound has on the human ear. As a quantity it is therefore complicated but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

7.3.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations, published by the Department of Environmental Affairs and Tourism (DEAT, 2002) in terms of the NEMA, SANS 10103 as well as guidelines from the World Health Organization (WHO).

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations, an increase of more than 7 dBA is considered a disturbing noise. See also **Figure 7-2**.
- *Zone Sound Levels:* Previously referred as the acceptable rating levels, it sets acceptable noise levels for various areas. See also **Table 7.1**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. However, anything above this level is considered unacceptable.

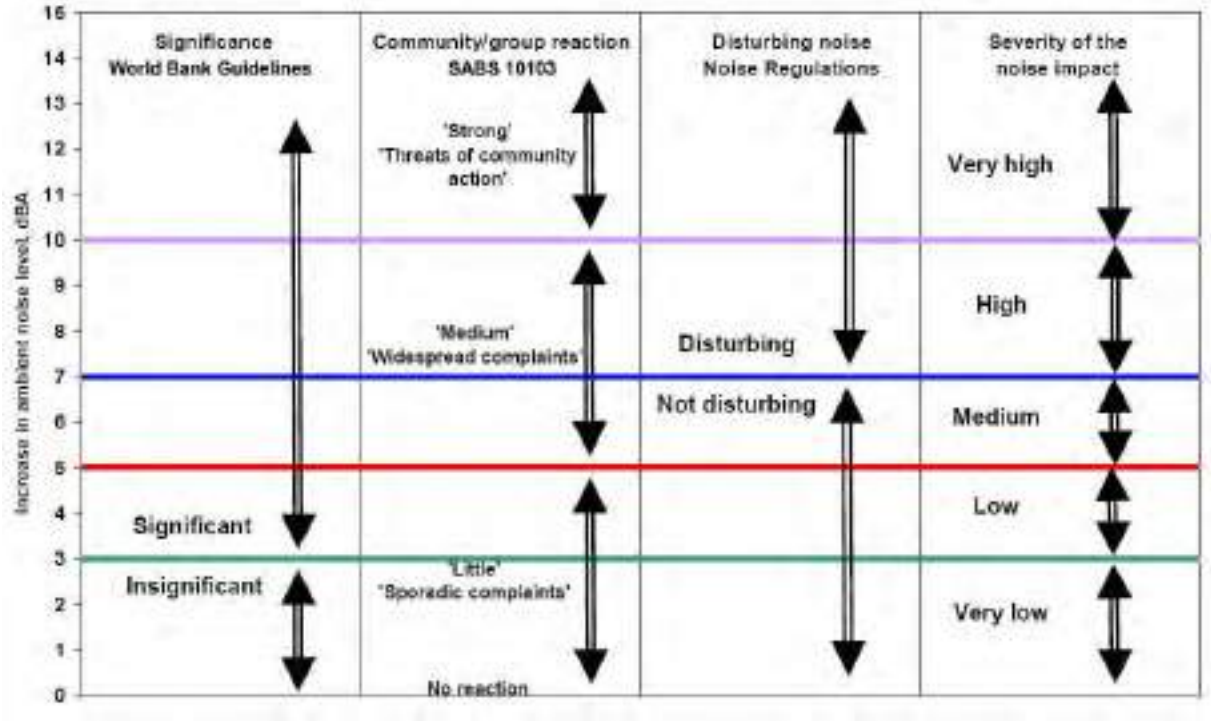

Figure 7-2: Criteria to assess the significance of impacts stemming from noise

In South Africa the document that addresses the issues concerning environmental noise is SANS 10103. See also **Table 6.1**. It provides the maximum average ambient noise levels, $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed. For rural areas the Zone Sound Levels (Rating Levels) are (during wind-still conditions):

- Day (06:00 to 22:00) - $L_{Req,d}$ = 45 dBA, and
- Night (22:00 to 06:00) - $L_{Req,n}$ = 35 dBA.

SANS 10103 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in noise level, the following criteria are of relevance:

- **Δ ≤ 3 dBA:** An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- **3 < Δ ≤ 5 dBA:** An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- **5 < Δ ≤ 15 dBA:** An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an

increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

In addition, it should be noted that the Noise Control Regulations defines disturbing noise to be any change in the ambient noise levels higher than 7 dBA than the background.

Table 7.1: Acceptable Zone Sound Levels for noise in districts (SANS 10103)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req,T}$) for noise** dBA					
	Outdoors			**Indoors, with open windows**		
	Day/night $L_{R,dn}$[a]	**Daytime $L_{Req,d}$**[b]	**Night-time $L_{Req,n}$**[b]	**Day/night $L_{R,dn}$**[a]	**Daytime $L_{Req,d}$**[b]	**Night-time $L_{Req,n}$**[b]
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

7.3.3 Determining appropriate Zone Sound Levels

SANS 10103 unfortunately does not cater for instances when background noise levels change due to the impact of external forces. Locations close to the sea for instance always have a background noise level exceeding 35 dBA, and, in cases where the sea is rather turbulent, it can easily exceed 45 dBA. Similarly, noise induced by high winds is not included.

Setting noise limits relative to the background noise level is relatively straightforward when the prevailing background noise level and source level are constant. However, wind turbines emit noise that is related to wind speed, and the environment within which they are heard will probably also be dependent upon the strength of the wind and the noise associated with its effects. It is therefore necessary to derive a background noise level that is indicative of the noise environment at the receiving property for different wind speeds so that the turbine noise level at any particular wind speed can be compared with the background noise level in the same wind conditions.

Therefore, when assessing the overall noise levels emitted by a wind farm it is necessary to consider the full range of operating wind speeds of the wind turbines. This covers the wind speed range from around 3-5m/s (the turbine cut-in wind speed) up to a wind speed range of 25-35m/s measured at the hub height of a wind turbine. However, the Noise Working Group proposes that noise limits only be placed up to a wind speed of 12 m/s for the following reasons:

1. Wind speeds are not often measured at wind speeds greater than 12m/s at 10m height.
2. Reliable measurements of background noise levels and turbine noise will be difficult to make in high winds due to the effects of wind noise on the microphone and the fact that one could have to wait several months before such winds were experienced.
3. Turbine manufacturers are unlikely to be able to provide information on sound power levels at such high wind speeds for similar reasons.
4. If a wind farm meets noise limits at wind speeds lower than 12 m/s it is unlikely to cause any greater loss of amenity at higher wind speeds. Whilst turbine noise levels will still be reasonably constant, even in sheltered areas the background is likely to contain much banging and rattling due to the force of the wind.

Available data indicates that noises from a Wind Turbine is drowned by other noises (wind howling around building, rustling of leaves in trees, rattling noises, etc) above a wind speed of 8 – 10 m/s, even if the wind blows in the direction of the receiver.

A typical background noise vs. wind speed regression curve is illustrated in **Figure 7-3**. It should be noted that curves for daytime (6:00 – 22:00) and night time (22:00 – 6:00) would be different, but as wind speeds increase, the wind induced noise levels approach each other (wind speeds exceeding 15 m/s).

The curve was developed by plotting all measurement data (as collected by the author during periods when the wind was blowing) and fitting a curve through the points. The measurement points were selected to be away from structures (buildings, trees, etc.) that could significantly impact the ambient sound levels during high winds. This is because ambient sound levels are generally significantly higher closer to dwellings or other structures than at points further away from such structures (during times when a wind is blowing). In addition data collected when other noise sources were present (traffic, industrial noises) were not included.

For the purpose of the EIA, **Figure 7-3** will be considered, together with the zone sound levels as stipulated in SANS 10103.

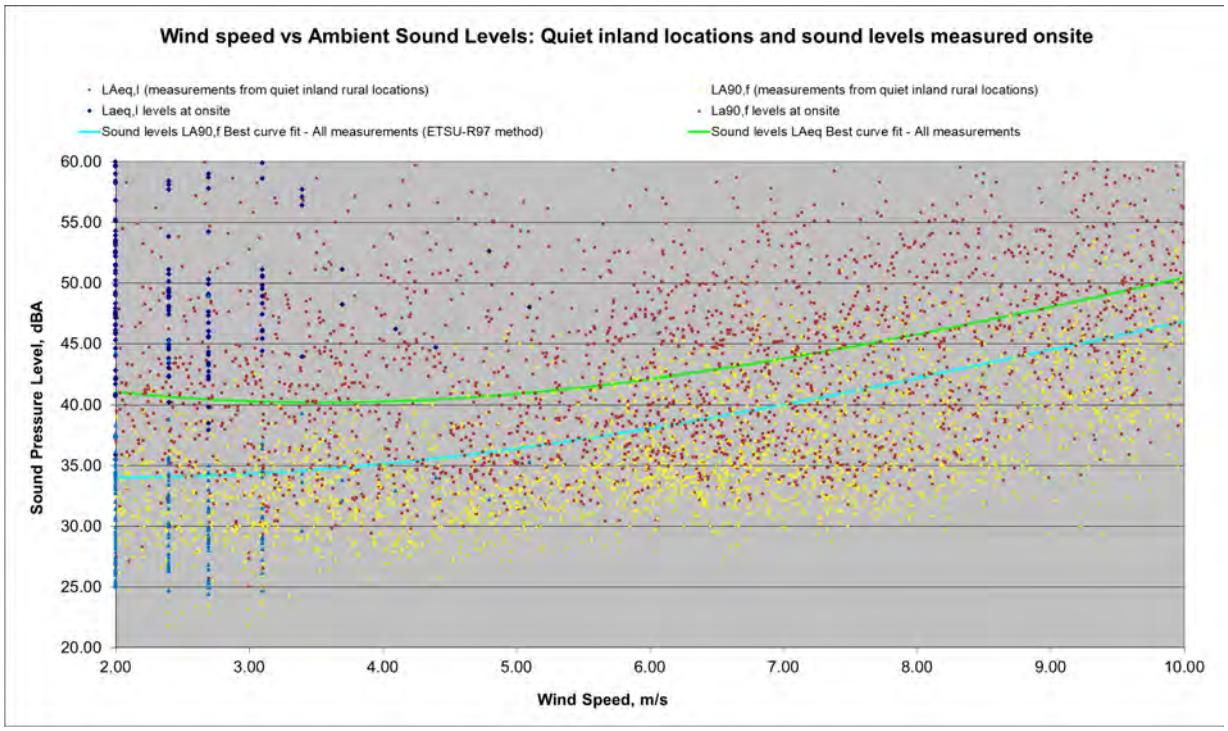

Figure 7-3: Ambient sound measurements and noise criteria curve considering wind speeds

7.3.4 Determining the Significance of the Noise Impact

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect will be assigned a value as defined in the third column in the tables below during the Environmental Noise Impact Assessment stage.

The impact consequence is determined by the summing the scores of Magnitude (**Table 7.2**), Duration (**Table 7.3**) and Spatial Extent (**Table 7.4**). The impact significance is determined by multiplying the Consequence result with the Probability score (**Table 7.5**).

An explanation of the impact assessment criteria is defined in the following tables.

Table 7.2: Impact Assessment Criteria - Magnitude

This defines the impact as experienced by any receptor. In this report the receptor is defined as any resident in the area, but excludes faunal species.		
Rating	**Description**	**Score**
Minor	Increase in average sound pressure levels between 0 and 3 dB from the expected wind induced ambient sound level (proposed rating level). No change in ambient sound levels discernable. Total projected noise level is less than the Zone Sound Level in wind-still conditions.	2
Low	Increase in average sound pressure levels between 3 and 5 dB from the (expected) ambient sound level (proposed rating level). The change is barely discernable, but the noise source might become audible.	4
Moderate	Increase in average sound pressure levels between 5 and 7 dB from the (expected) ambient sound level (proposed rating level). Sporadic complaints expected. Any point where the zone sound levels are exceeded during wind still conditions.	6
High	Increase in average sound pressure levels between 7 and 10 dB from the (expected) ambient sound level (proposed rating level). Medium to widespread complaints expected.	8
Very High	Increase in average sound pressure levels higher than 10 dBA from the (expected) ambient sound level (proposed rating level). Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action. Any point where noise levels exceed 65 dBA at any receptor.	10

Table 7.3: Impact Assessment Criteria - Duration

The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operational and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.		
Rating	**Description**	**Score**
Temporary	Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional (0 - 1 years).	1
Short term	Impacts that are predicted to last only for the duration of the construction period (1 - 5 years).	2
Medium term	Impacts that will continue for a part of the operational phase, well after the construction phase stopped (5 – 15 years).	3
Long term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating (> 15 years).	4
Permanent	Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	5

Table 7.4: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact (defined as the area where the noise impact may change the ambient sound levels with 7 dBA or more)		
Rating	**Description**	**Score**
Site	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1
Local	The impact could affect the local area (within 1,000 m from site).	2
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns (further than 1,000 m from the site).	3
National	The impact could have an effect that expands throughout the country (South Africa).	4
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.	5

Table 7.5: Impact Assessment Criteria - Probability

This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:		
Rating	**Description**	**Score**
Very improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).	1
Improbable / Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined to be up to 25 %.	2
Probable / Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined to be between 25% and 50 %.	3
Highly Probable / Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined to be between 50 % to 75 %.	4
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined to be between 75% and 100 %.	5

7.3.5 Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a value for each impact (prior to the implementation of mitigation measures). Significance without mitigation is rated on the following scale:

SR < 30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30 < **SR** < 60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR > 60	High (H)	Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

7.3.6 Identifying the Potential Impacts with Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale:

SR < 30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30 < **SR** < 60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR > 60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after

		mitigation could render the entire development option or entire project proposal unacceptable.

7.4 EXPRESSION OF THE NOISE IMPACTS

Sound or noise levels generally refers to a level as measured using an instrument, whereas the noise rating level refers to a calculated sound exposure level to which various corrections and adjustments was added. These noise rating levels are further processed into a 3D map illustrating noise contours of constant rating levels or noise isopleths. In this noise scoping report it can be used to define the potential extent of noises of the project and not a noise level at a specific moment in time.

The noise impacts can be expressed in terms of the increase in present ambient noise levels caused by noise emissions from the proposed project.

For the purpose of this Scoping document, predicted sound levels have only been included for illustrative purposes, as well as to indicate the potential overall spatial extent of noise impacts that wind turbines may have. The purpose is to identify areas of possible concern for both the developer as well as stakeholders, highlighting important criteria for the EIA phase.

8 RESULTS AND PRELIMINARY IMPACT ASSESSMENT

8.1 CONSTRUCTION PHASE

Projected impacts from the construction phase can only be modelled once more information regarding the duration of construction and equipment used are known. Therefore the construction phase will only be dealt with in more detail during the Environmental Noise Impact Assessment phase.

As no specific construction details or possible locations of major ancillary activity sites are available at this stage, the anticipated noise from various types of construction activities cannot be calculated and will only be estimated.

Considering the location of the project site in relation to the closest potential NSDs, there are a number of potential receptors that can be influenced by sounds from these wind turbines.

Based on **Table 4.1**, maximum noise levels could be in the region of 90 – 105 dBA when working in close quarters to equipment (within 5 m), but noise levels will reduce the further a conceptual receptor (such as employees) is from construction activities. For all construction work, the workers working with or in close proximity to equipment will be exposed to high levels of noise as can be seen from **Table 4.1** (when working within 10 m of noisy equipment).

While maximum noise levels may reach up to 60 dBA at 1,000 meters (worst-case scenario for a pile driver), such noise levels are not a constant, and equivalent A-weighted noise levels can range between 56 (at 500m for a Rock Breaker) and 50 dBA (at 1,000 for a Rock Breaker) (refer also **Table 4.2**).

There are number of potential NSDs identified living within and adjacent to the properties where construction activities can take place. These activities can increase the noise levels at these receptors, with the levels either changing the ambient sound levels with more than 7 dB or resulting in noise levels higher than the rural night-time rating levels (potentially exceeding the levels recommended by international guidelines such as IFC - see also **section 2.6.5**).

During the EIA phase construction activities such as the (potential) borrow pit, concrete batching/delivery, foundation preparation, the digging of trenches and increased traffic (deliveries and movement onsite) will be considered, taking cognisance of the worst-case scenario (simultaneous activities close to a NSD(s)).

8.2 OPERATIONAL PHASE: ESTIMATED IMPACT AND IMPORTANT CONCEPTS

This preliminary operational assessment makes use of the data defined in **Table 4.2.** This will allow defining extent and potential magnitude of noise rating levels.

This Scoping document considers, as will the Environmental Noise Impact Assessment, the impacts on the surrounding noise environment during times when a quiet environment is highly desirable. Noise limits should therefore be appropriate for the most noise-sensitive activity.

Noise-sensitive activities such as sleeping, or areas used for relaxation or other activities (places of worship, school, etc.) should determine appropriate Zone Sound Levels. However, for this Scoping report the $L_{Req,N}$ of **35dBA** as proposed by SANS 10103 is used.

Considering the location of the project site in relation to the closest potential NSDs, there is a potential for a noise impact when considering the noise levels presented in **Table 4.2**, noise rating levels could be as high as 42 dBA (using the sound power emission data of the Vestas V117 3.3MW) at 500m which is higher than the SANS 10103 night-time rating level of 35dBA.

It should be noted that this is a simplistic model, as the exact noise rating level will depend on factors such as:

- Total number of wind turbines operating within a distance of 2,000m that can cumulatively increase the noise levels,
- Atmospheric conditions that can assist in the attenuation of the sound levels,
- Ground conditions, that can assist in absorbing some of the acoustic energy of certain frequencies reflected from the ground,
- Height corrections.

Based on noise measurements collected at actual wind farms as well as noise modelling completed for various projects, multiple wind turbines within 1,000m could result in noise levels higher than 45 dBA. This must be considered during the Environmental Noise Impact Assessment phase once a layout is available. However, considering the potential noise level of 42 dBA (potential noise rating level at 500m from a Vestas V117 3.3MW wind turbine), no wind turbines should be developed within 500m from any NSD.

9 PRELIMINARY SIGNIFICANCE OF THE NOISE IMPACT

9.1 CONSTRUCTION PHASE NOISE IMPACT

The impact assessment for the various activities defined in **Section 4.1** and assessed in **Section 8.1** that can create noise and may impact on the surrounding environment is summarized in the following **Table 9-1**.

Table 9-1: Scoping level Noise Impact Assessment: Construction Activities

Impacts:			
Increases in noise levels at closest receptors. Noise levels exceeding the SANS 10103 rating level.			
Desktop Sensitivity Analysis: Rural area with daytime $L_{R,d}$ rating level of 45 dBA. Rural area with night-time $L_{R,n}$ rating level of 35 dBA.			
Issue	**Nature of Impact**	**Extent of Impact**	**No-go areas**
Increase in noise level at receptors. Disturbing noises. Noises exceeding rating level.	Increased noises or disturbing noises may increase annoyance levels with project. Noise levels could reach 56 dBA during construction.	Multiple construction activities taking place simultaneously may impact an area within 2,000m from the activities	No wind turbines to be developed within 500m from identified NSD and prevent the development of access roads within 250m from these NSD
Description of expected significance of impact: Without noise propagation modeling it is difficult to access the potential significance of the noise impact. However, if the developer only constructs wind turbines further than 500m from identified NSD, the potential significance could be medium (night-time construction activities mainly) to low, with the noise impact depending on the type and number of construction activities taking place simultaneously. These noise impacts: (a) Is highly reversible; (b) Will not result in the irreplaceable loss of resources; and (c) Potential noise impacts can be managed, mitigated or even avoided.			
Gaps in Knowledge: Accurate noise rating levels to be modeled during EIA phase once a layout is available.			
Comments: Low confidence in assessment.			
Mitigation Measures: Mitigation (if required) will depend on the layout of infrastructure (location where construction activities could take place) and the significance of the potential noise impact.			
Recommendations: Scoping level assessment is not sufficient, full Environmental Noise Impact Assessment is required.			

9.2 OPERATIONAL PHASE NOISE IMPACT

The impact assessment for the various activities defined in **Section 4.2** and calculated in **section 8.2** will increase the ambient noise levels in the area. The noise impact is assessed and summarized in the following **Table 9-2**. Only the night-time scenario was assessed as this is the most critical time period when a quiet environment is desired.

Table 9-2: Impact Assessment: Operational Activities

Impacts: Increases in noise levels at closest receptors. Noise levels exceeding the SANS 10103 rating level.			
Desktop Sensitivity Analysis: Rural area with night-time $L_{R,n}$ rating level of 35 dBA, although data indicate that noise levels increase as the wind speeds increase.			
Issue	**Nature of Impact**	**Extent of Impact**	**No-go areas**
Increase in noise level at receptors. Noises exceeding rating level.	Increased noises may increase annoyance levels with project. Noise levels could reach 42 dBA during the operation phase.	Multiple wind turbines operating at night could impact on an area up to 2,000m from the turbines.	No wind turbines to be developed within 500m from identified NSD
Description of expected significance of impact: Without noise propagation modeling it is difficult to access the potential significance of the noise impact. However, if the developer only develops wind turbines further than 500m from identified NSD, the potential significance could be medium to low, with the noise impact depending on the specific sound power emission characteristics of the wind turbine as well as the number of wind turbines located within 2,000m from these NSD (cumulative effects). These noise impacts: (a) Is reversible at the end of the project; (b) Will not result in the irreplaceable loss of resources; and (c) Potential noise impacts can be managed, mitigated or even avoided.			
Gaps in Knowledge: Accurate noise rating levels to be modeled during EIA phase once a layout and the details of the selected wind turbine are available.			
Comments: Low confidence in assessment.			
Mitigation Measures: Mitigation (if required) will depend on the layout of the wind farm, the exact details of the wind turbine selected and the significance of the potential noise impact.			
Recommendations: Scoping level assessment is not sufficient, full Environmental Noise Impact Assessment is required.			

10 CONCLUSIONS

This report is a Scoping assessment of the predicted noise environment due to the development of phase 1 of the Kuruman WF on various farms in the vicinity of Kuruman. It is based on a desktop assessment as well as a basic predictive model to identify potential issues of concern.

This assessment indicated that the proposed project could have a noise impact on the surrounding area as there may be NSD within the area of acoustical influence of the wind turbines in the project area. The main factors that will determine the potential noise impact is the distance that the wind turbines of the wind farm would be from a NSD, the sound power emission characteristics of the selected wind turbine and the total number of wind turbines that could cumulatively impact on this NSD.

The results of the evaluation indicated that certain data (see **Recommendations – Section 11**) is critical in order to define the noise impact on NSDs during the EIA phase.

Wind Turbines do emit noises at sufficient levels to propagate over large distances. The fact that there would be a number wind turbines operating simultaneously in an area where there are noise-sensitive developments increase the possibility that a noise impact could occur. At this preliminary stage it is impossible to determine whether the significance of this noise impact would be low, medium or high.

However, other projects (local and international) indicated that with the implementation of correct mitigation measures (especially a sufficient setback or buffer zone, see **Figure 10-1**) it would be possible to minimize the potential noise risks and reduce the noise impacts to a more acceptable medium or low significance.

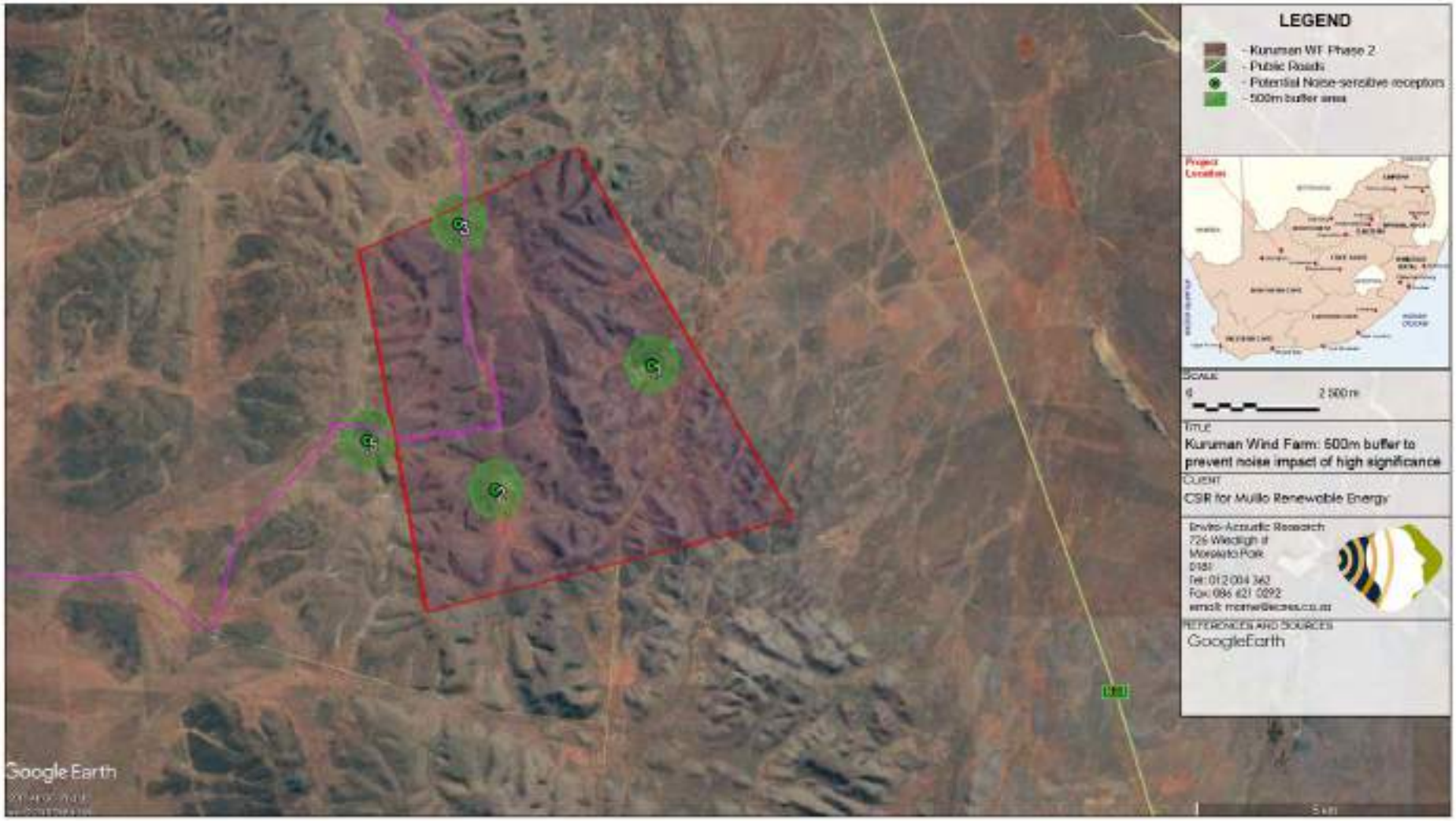

Figure 10-1: Proposed buffer area to prevent a noise impact of high significance

11 RECOMMENDATIONS

This assessment indicated that the development of phase 1 of the Kuruman WF could have a potential noise impact on the surrounding environment. The layout (main factor) and selection of the wind turbine (minor factor) will determine the potential magnitude of such a noise impact.

It is recommended that the potential noise impact associated with the proposed WF be investigated in more detail in the Environmental Impact Assessment phase.

The following information is considered critical:

1. The exact locations of the various wind turbines in the WF (final layout); and
2. The Sound Power Emission Levels of the selected Wind Turbine.

12 TERMS OF REFERENCE FOR THE ENVIRONMENTAL NOISE IMPACT PHASE

Work that will take place during the Environmental Noise Impact Assessment phase is defined in section 8 of SANS 10328:2008.

12.1 PURPOSE OF THE ENVIRONMENTAL NOISE IMPACT ASSESSMENT

The purpose of an environmental noise impact investigation and assessment is to determine and quantify the acoustical impact of, or on a proposed development.

12.2 PLAN OF STUDY FOR ENVIRONMENTAL NOISE IMPACT INVESTIGATION AND ASSESSMENT

In this regard the following will be included to assist the EAP in the compilation of the Plan of Study (PoS) for the EIA:

- Development of a digital terrain model of the area using the topographical contours of the area;
- Development of a noise propagation model using the data as received from the developer to estimate the potential noise level from the WF;
- The potential impact will be evaluated (where possible) in terms of the nature (description of what causes the effect, what/who might be affected and how it/they might be affected) as well as the extent of the impact;
- The potential significance of the identified issues will be calculated based on the evaluation of the issues/impacts;
- The development of an Environmental Management Plan and a proposal of potential mitigation measures (if required); and
- Recommendations.

12.3 ENVIRONMENTAL NOISE IMPACT INVESTIGATION

12.3.1Sound emission from the identified noise sources

Sound emission data as warranted by the wind turbine manufacturer would be used to calculate the potential noise emissions from the wind turbines. In the instance that this data is unavailable, sound emission data as measured and calculated in accordance with EIA 61400-11 (Wind turbine generator systems – Part 11: Acoustic noise measurements techniques) could be used.

The operating cycle and nature of the sound emission (impulsiveness, tonal character or potential low frequencies) would, where relevant, be considered when the expected rating level in the target area is calculated.

12.3.2 Determination of Rating levels

The Concawe model defined in SANS 10357:2004 (construction phase) as well as the propagation model defined in ISO 9613-2 (operation phase) will be used to calculate projected equivalent noise levels.

Other input parameters used would include:

- Atmospheric pressure of 100 kPa;
- Air temperature of 20 ^{o}C;
- Relative humidity of 80%;
- Prevailing wind direction as input into Concawe model as made available by developer;
- Appropriate ambient sound levels associated with a selected wind speed;
- Layout of the proposed facility as provided by the developer;
- Topography details;
- Height of turbine above sea level as well as height of wind turbine above surface level;
- Projected outside equivalent noise levels at Potentially Sensitive Receptors at height above sea-level (plus 1.5 meters);
- 75% soft ground surface.

12.3.3 Assessment of the noise impact: No mitigation

The significance will be determined considering the defined magnitude of the noise level, the extent as well as the duration of the projected noise impact, as well as the probability that this impact may take place.

The magnitude of the noise impact will be assessed by considering:

- The total projected cumulative noise level compared to the appropriate acceptable rating levels as defined in table 2 of SANS 10103:2008;
- The potential community response from table 5 of SANS 10103:2008. In addition, other relevant and suitable literature may be consulted as defined in the scoping report. In particular the likely ambient sound levels due to wind induced noises will be estimated at the wind speed under investigation and considered; and

- Projected noise levels considering the likely and projected ambient sound levels (refer also to **Figure 7-3**).

Likely ambient sound levels associated with wind speeds as well as the projected change in ambient sound levels would also be considered when estimating the probability that a NSD may be impacted by increased noise levels.

12.3.4 Assessment of the noise impact: Implementation of mitigation measures

Should the significance of the impact be medium or high, the potential significance will be recalculated considering that the developer would be implementing reasonable mitigation measures.

12.4 ENVIRONMENTAL NOISE IMPACT REPORT

The Environmental Noise Impact Report will cover the following points:

- the purpose of the investigation;
- a brief description of the planned development or the changes that are being considered;
- a brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements;
- the identified noise sources together with their respective sound pressure levels or sound power levels (or both) and, where applicable, the operating cycles, the nature of sound emission, the spectral composition and the directional characteristics;
- the identified noise sources that were not taken into account and the reasons as to why they were not investigated;
- the identified Potentially Sensitive Receptors and the noise impact on them;
- where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics;
- an explanation, either by a brief description or by reference, of all measuring and calculation procedures that were followed, as well as any possible adjustments to existing measuring methods that had to be made, together with the results of calculations;
- an explanation, either by description or by reference, of all measuring or calculation methods (or both) that were used to determine existing and predicted rating levels, as well as other relevant information, including a statement of how the data were obtained and applied to determine the rating level for the area in question;

- the location of measuring or calculating points in a sketch or on a map;
- quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made;
- alternatives that were considered and the results of those that were investigated;
- a list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation (if comments are received);
- a detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them (if comments are received);
- conclusions that were reached;
- proposed recommendations including potential mitigation measures;
- any follow-up investigation which should be conducted at completion of the project as well as at regular intervals after the commissioning of the project so as to ensure that the recommendations of this report will be maintained in the future.

13 THE AUTHOR

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining related courses (Rock Mechanics, Surveying, Sampling, Safety and Health [Ventilation, noise, illumination etc] and Metallurgy. He did work in both underground (Coal, Gold and Platinum) as well as opencast (Coal) for 4 years. He changed course from Mining Engineering to Chemical Engineering after his second year of his studies at the University of Pretoria.

After graduation he worked as a Water Pollution Control Officer at the Department of Water Affairs and Forestry for two years (first year seconded from Wates, Meiring and Barnard), where duties included the perusal (evaluation, commenting and recommendation) of various regulatory required documents (such as EMPR's, Water Licence Applications and EIA's), auditing of licence conditions as well as the compilation of Technical Documents.

Since leaving the Department of Water Affairs, Morné has been in private consulting for the last 15 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing these projects within budget and timeframe. During that period he gradually moved towards environmental acoustics, focusing on this field exclusively since 2007.

He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. He has been doing work in this field for the past 8 years, and was involved with the following projects in the last few years:

Wind Energy Facilities	*Full Environmental Noise Impact Assessments for - Bannf (Vidigenix), iNCa Gouda (Aurecon SA), Kangnas (Aurecon), Plateau East and West (Aurecon), Wolf (Aurecon), Outeniqwa (Aurecon), Umsinde Emoyeni (ARCUS) , Komsberg (ARCUS), Karee and Kolkies Wind Farms (ARCUS), Canyon Springs (Canyon Springs), Perdekraal (ERM), Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Happy Valley (SE), Deep River (SE), Tsitsikamma (SE), AB (SE), West Coast One (SE), Hopefield II (SE), Namakwa Sands (SE), VentuSA Gouda (SE), Dorper (SE), Amakhala Emoyeni (SE), Klipheuwel (SE), Cookhouse (SE), Cookhouse II (SE), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Koningaas (SE), Eskom Aberdene (SE), Spitskop (SE), Castle (SE), Khai Ma (SE), Poortjies (SE), Korana (SE), IE Moorreesburg (SE), Gunstfontein (SE), Vredenburg (Terramanzi), Loeriesfontein (SiVEST), Rhenosterberg*

	(SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Dwarsrug (SiVEST), Msenge Emoyeni (Windlab), Isivunguvungu Wind Farm (Aurecon), Graskoppies (SiVEST), Hartebeest Leegte (SiVEST), Ithemba (SiVEST), !Xha Boom (SiVEST), Kokerboom 1 (Aurecon), Kokerboom 2 (Aurecon), Teekloof (Mainstream), Sutherland (CSIR), Rietrug (CSIR), Sutherland 2 (CSIR), Spitskop West (Terramanzi)
Mining and Industry	*Full Environmental Noise Impact Assessments for – Delft Sand (AGES), BECSA – Middelburg (Golder Associates), Kromkrans Colliery (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream Environmental), Evraz Vametco Mine and Plant (JMA), Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream Environmental), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream Environmental), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream Environmental), EastPlats (CleanStream Environmental), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Glencore Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali Environmental), Fumani Gold (AGES), Leiden Coal (EIMS), Colenso Coal and Power Station (SiVEST/EcoPartners), Klippoortjie Coal (Gudani), Rietspruit Crushers (MENCO), Assen Iron (Tshikovha), Transalloys (SE), ESKOM Ankerlig (SE), Pofadder CSP (SE), Nooitgedacht Titano Project (EcoPartners), Algoa Oil Well (EIMS), Spitskop Chrome (EMAssistance), Vlakfontein South (Gudani), Leandra Coal (Jacana), Grazvalley and Zoetveld (Prescali), Tjate Chrome (Prescali), Langpan Chromite (Prescali), Vereeniging Recycling (Pro Roof), Meyerton Recycling (Pro Roof), Hammanskraal Billeting Plant 1 and 2 (Unica), Development of Altona Furnace, Limpopo Province (Prescali Environmental), Haakdoorndrift Opencast at Amandelbult Platinum (Aurecon), Landau Dragline relocation (Aurecon), Stuart Coal Opencast (CleanStream Environmental), Tetra4 Gas Field Development (EIMS), Kao Diamonds – Tiping Village Relocation (EIMS), Kao Diamonds – West Valley Tailings Deposit (EIMS), Upington Special Economic Zone (EOH), Arcellor Mittal CCGT Project near Saldanha (ERM), Malawi Sugar Mill Project (ERM), Proposed Mooifontein Colliery (Geovicon Environmental), Goedehoop North Residue Deposit Expansion (Geovicon Environmental), Mutsho 600MW Coal-Fired Power Plant (Jacana Environmentals), Tshivhaso Coal-Fired Power Plant (Savannah Environmental), Doornhoek Fluorspar Project (Exigo)*
Road and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane), Transnet Apies-river Bridge Upgrade (Transnet), Gautrain Due-diligence (SiVest), N2 Piet Retief (SANRAL), Atterbury Extension, CoT (Bokomoso Environmental)*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping (Aurecon)*
Noise monitoring and Audit Reports	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), Doxa Deo (Doxa Deo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional (Xstrata), Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF Ambient Sound Level study (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Hopefield WEF Noise Analysis (Umoya), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon), Jeffries Bay Wind Farm (Globeleq), Sephaku Aganang (Exigo),*

	Sephaku Delmas (Exigo), Beira Audit (BP/GPT), Nacala Audit (BP/GPT), NATREF (Nemai), Rappa Resources (Rayten), Measurement Report for Sephaku Delmas (Ages), Measurement Report for Sephaku Aganang (Ages), Development noise measurement protocol for Mamba Cement (Exigo), Measurement Report for Mamba Cement (Exigo), Measurement Report for Nokeng Fluorspar (Exigo), Tsitsikamma Community Wind Farm Pre-operation sound measurements (Cennergi), Waainek WEF Operational Noise Measurements (Innowind), Sedibeng Brewery Noise Measurements (MENCO), Tsitsikamma Community Wind Farm Operational noise measurements (Cennergi), Noupoort Wind Farm Operational noise measurements (Mainstream),
Small Noise Impact Assessments	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (Noman Shaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion 2 (AECOM), Babalegi Steel Recycling (AGES), Safika Ladium (AGES), Safika Cement Isando (AGES), RareCo (SE), Struisbaai WEF (SE), Perdekraal WEF (ERM), Kotula Tsatsi Energy (SE), Olievenhoutbosch Township (Nali), , HDMS Project (AECOM), Quarry extensions near Ermelo (Rietspruit Crushers), Proposed uMzimkhulu Landfill in KZN (nZingwe Consultancy), Linksfield Residential Development (Bokomoso Environmental), Rooihuiskraal Ext. Residential Development, CoT (Plandev Town Planners), Floating Power Plant and LNG Import Facility, Richards Bay (ERM), Floating Power Plant project, Saldanha (ERM), Vopak Growth 4 project (ERM), Elandspoort Ext 3 Residential Development (Gibb Engineering)*
Project reviews and amendment reports	*Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma Community Wind Farm Noise Simulation project (Cennergi), Amakhala Emoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (SE), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy), De Aar WEF (Holland), Quarterly Measurement Reports – Dangote Delmas (Exigo), Quarterly Measurement Reports – Dangote Lichtenburg (Exigo), Quarterly Measurement Reports – Mamba Cement (Exigo), Quarterly Measurement Reports – Dangote Delmas (Exigo) Quarterly Measurement Reports – Nokeng Fluorspar (Exigo), Proton Energy Limited Nigeria (ERM), Hartebeest WEF Update (Moorreesburg) (Savannah Environmental), Modderfontein WEF Opinion (Terramanzi), IPD Vredenburg WEF (IPD Power Vredenburg)*

14 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2010, and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010.

_____
Signature of the environmental practitioner:

Enviro-Acoustic Research cc
Name of company:

_____
Date:

15 REFERENCES

In this report reference was made to the following documentation:

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following, but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called “no go” alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means 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 a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65 dBA; or (ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period extending from 06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a

	period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or (c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 7 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments has been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does

	not include the total study area.
Free Field Condition	An environment where there is no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Green field	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	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.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} *and* L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by

	damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.
Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and health care buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report Noise-sensitive developments is also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1] second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.

Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS 10103:2008.

APPENDIX B

Photos of measurement locations

Photos 1: Measurement Location MKWFASLT01

Photos 2: Measurement Location MKWFASLT02

Photos 3: Measurement Location MKWFASLT03

End of Report

TRANSPORT STUDY:

for the Proposed Development of the Phase 2 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province: SCOPING REPORT

Report prepared for:

CSIR – Environmental Management Services

P O Box 320

Stellenbosch

7600

Report prepared by:

JG AFRIKA (PTY) LTD

Branch: Cape Town

PO Box 38561

7430

11 April 2018

VERIFICATION PAGE	Form 4.3.1
	Rev 13

TITLE:
TRANSPORT STUDY FOR THE PROPOSED DEVELOPMENT OF THE PHASE 2 KURUMAN WIND ENERGY FACILITY NEAR KURUMAN IN THE NORTHERN CAPE

JGA REF. NO.	DATE:	REPORT STATUS
4686	11/04/2017	First Issue

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AUTHOR

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CLIENT CONTACT PERSON

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SYNOPSIS

Preparation of a Transport Study for the proposed development of the Phase 2 Kuruman Wind Energy Facility near Kuruman in the Northern Cape, pertaining to all relevant traffic and transportation engineering aspects.

KEY WORDS:

Wind Energy Facility, Transport Study

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2008 which has been independently certified by DEKRA Certification under certificate number 90906882

Verification	Capacity	Name	Signature	Date
By Author	Senior Technologist	Adrian Johnson		11/04/18
Checked by:	Associate	Iris Wink		11/04/18
Authorised by:	Executive Associate	Jürgen Gentz		11/04/2018

Filename:	4686/Reports/Phase 2

IRIS SIGRID WINK

Profession	Civil Engineer (Traffic & Transportation)
Position in Firm	Associate
Area of Specialisation	Manager: Traffic & Transportation Engineering
Qualifications	PrEng, MSc Eng (Civil & Transportation)
Years of Experience	15 Years
Years with Firm	5 Years

SUMMARY OF EXPERIENCE

Iris is a Professional Engineer registered with ECSA (20110156). She joined JG Afrika (Pty) Ltd. in 2012. Iris obtained a Master of Science degree in Civil Engineering in Germany and has more than 15 years of experience in a wide field of traffic and transport engineering projects. Iris left Germany in 2003 and has worked as a traffic and transport engineer in South Africa and Germany. She has technical and professional skills in traffic impact studies, public transport planning, non- motorised transport planning and design, design and development of transport systems, project planning and implementation for residential, commercial and industrial projects and providing conceptual designs for the abovementioned. She has also been involved with transport assessments for renewable energy projects and traffic safety audits.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

PrEng - Registered with the Engineering Council of South Africa No. 20110156
Registered Mentor with ECSA for the Cape Town Office of JG Afrika
MSAICE - Member of the South African Institution of Civil Engineers
ITSSA - Member of ITS SA (Intelligent Transport Systems South Africa)
SAWEA - Member of the South African Wind Energy Association
SARF - South African Road Federation: Committee Member of Council

EDUCATION

1996 - Matric – Matric (Abitur) – Carl Friedrich Gauss Schule, Hemmingen, Germany
1998 - Diploma as Draughtsperson – Lower Saxonian State Office for Road and Bridge Engineering
2003 - MSc Eng (Civil and Transportation) – Leibniz Technical University of Hanover, Germany

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)

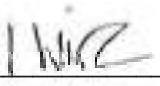
2016 – Date
Position – Associate

- **Coega West Windfarm** – Transportation and Traffic Management Plan for the Coega Windfarm in Coega, Port Elizabeth – Client: Electrawinds Coega
- **Traffic and Parking Audits** for the Suburb of Groenvallei in Cape Town – Client: City of Cape Town Department of Property Management.
- **Road Safety Audit** for the Upgrade of N1 Section 4 Monument River – Client: Aurecon on behalf of SANRAL
- **Sonop Windfarm** – Traffic Impact Assessment for the Sonop Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Universal Windfarm** - Traffic Impact Assessment for the Universal Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Road Safety Audit** for the Upgrade of N2 Section 8 Knysna to Wittedrift – Client: SMEC on behalf of SANRAL
- **Road Safety Audit** for the Upgrade of N1 Section 16 Zandkraal to Winburg South – Client: SMEC on behalf of SANRAL
- **Traffic and Road Safety Studies** for the Improvement of N7 Section 2 and Section 3 (Rooidraai and Piekenierskloof pass) – Client: SANRAL
- **Road Safety Appraisal**s for Northern Region of Cape Town – Client: Aurecon on behalf of City of Cape Town (TCT)
- **Traffic Engineering Services** for the Enkanini Informal Settlement, Kayamandi - Client: Stellenbosch Municipality
- **Lead Traffic Engineer** for the Upgrade of a 150km Section of the National Route N2 from Kangela to Pongola in KwaZulu-Natal, Client: SANRAL
- **Traffic Engineering Services** for the Kosovo Informal Settlement (which is part of the Southern Corridor Upgrade Programme), Client: Western Cape Government
- **Traffic and Road Safety Studies** for the proposed Kosovo Informal Housing Development (part of the Southern Corridor Upgrade Program), Client: Western Cape Government.
- **Road Safety Audit** Stage 3 – Upgrade of the R573 Section 2 between Mpumalanga/Gauteng and Mpumalanga/Limpopo, Client: AECOM on behalf of SANRAL
- **Road Safety Audit** Stage 1 and 3 – Upgrade of the N2 Section 5 between Lizmore and Heidelberg, Client: Aurecon on behalf of SANRAL
- **Traffic Safety Studies** for Roads Upgrades in Cofimvaba, Eastern Cape – Client: Cofimvaba Municipality
- **Road Safety Audit** Stage 1 and 3 – Improvement of Intersections between Olifantshoek and Kathu, Northern Cape, Client: Nadeson/Gibb on behalf of SANRAL
- **Road Safety Audit** Stage 3 – Upgrade of the Beacon Way Intersection on the N2 at Plettenberg Bay, Client: AECOM on behalf of SANRAL
- **Traffic Impact Assessment** for a proposed Primary School at Die Bos in Strand, Somerset West, Client: Edifice Consulting Engineers
- **Road Safety Audit** Stage 1 and 3 – Improvement of R75 between Port Elizabeth and Uitenhage, Eastern Cape, Client: SMEC on behalf of SANRAL

SPECIALIST DECLARATION

I, **IRIS WINK** , as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of Specialist: IRIS WINK

Date: 11 April 2018

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TRANSPORT STUDY

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

Mulilo Renewable Project Developments (Pty) Ltd is proposing to develop the Kuruman Wind Energy Facility (WEF) just south of Kuruman and approximately 34km east of Kathu in the Northern Cape. The WEF will be developed in two phases – Phase 1 with 47 turbines and Phase 2 with 52 turbines. As part of the Environmental Impact Assessment (EIA) and Basic Assessment (BA) stages, the services of a Transportation Specialist are required to conduct respective Transportation Studies.

The main objective of this report is to prepare a transport study (traffic and transport risk assessment and route investigation) for the proposed Phase 2 Kuruman WEF site.

The following two main transportation activities will be investigated:

- Abnormal load vehicles transporting wind turbine components to the site.
- The transportation of construction materials, equipment and people to and from the site/facility.

The transport study plan will aim to provide the following objectives:

- Activities related to traffic movement for the construction, operation and maintenance of the wind energy facility.
- Provide a main route for the transportation of the wind turbine components from the entry point to the proposed site.
- Provide a preliminary transportation route for the transportation of materials, equipment and people to site.
- Outline traffic management issues for the proposed development.

1.1.2. Terms of Reference

The Terms of Reference for this Transport Study include the following:

- Extent of the transport study and study area;
- The proposed development;
- Assumptions concerning candidate turbines;
- Trip generation for the wind farm during construction and operation;
- Traffic impact on external road network;
- Accessibility and circulation requirements;
- National and local haulage routes between port of entry/manufacturer and site;
- Assessment of internal roads and site access;
- Assessment of freight requirements and permitting needed for abnormal loads; and
- Traffic accommodation during construction.

1.1.3. Approach and Methodology

The report deals with the traffic impact on the surrounding road network in the vicinity of the site during the construction of the access roads, construction and installation of the turbines and during maintenance.

This transport study includes the following tasks:

Site Visit and Project Assessment

- Site visit and initial meeting with the client to gain sound understanding of the project
- Overview of project background information including location maps, component specs and any resulting abnormal loads to be transported
- Research of all available documentation and information relevant to the proposed windfarm and substations

Correspondence with Authorities

- Correspondence with the relevant Authorities dealing with the external road network, such as SANRAL and Province

Traffic and Route Assessment

- Trip generation and potential traffic impact
- Possible haul routes between port of entry / manufacturing location and sites in regards of
    - National route
    - Local route
    - Site access route (internal roads)
    - Road limitations due to abnormal loads
- Construction and maintenance (operational) vehicle trips
    - Generated vehicles trips
    - Abnormal load trips
    - Access requirements
    - Possible damaging effects on road surface
    - Scheduling of transport (i.e. during night)
- Station data will be obtained as far as available from SANRAL for the closest national roads.
- Investigation of the impact of the development traffic generated during construction and operation.

Access and Internal Roads Assessment

- Assessment of the proposed access points including:
    - Feasible location of access points
    - Motorised and non-motorised access requirements
    - Queuing analysis and stacking requirements if required
    - Access geometry
    - Sight distances and required access spacing
- Assessment of the proposed internal roads on site
- Assessment of internal circulation of trucks and proposed roads layout in regard to turbine positions and turbine laydown areas

Report (Documentation and Figures)

- Reporting on all findings and preparation of the report.

1.1.4. Assumptions and Limitations

The following assumptions and limitations apply:

- This study is based on the project information provided by Mulilo/CSIR and the subsequent site visit.
- Due to access constraints during the site visit and the topography of the area, certain sections of the proposed WEF development could not be assessed and reasonable assumptions have been made.
- The exact turbine locations have not been finalized and the marked turbine corridors were therefore used as an indication of the possible location.

- According to the Eskom Specifications for Power Transformers, the following dimensional limitations need to be kept when transporting the transformer – total maximum height 5 000mm, total maximum width 4 300mm and total maximum length 10 500mm.
- Maximum vertical height clearances along the haulage route is 5.2m for abnormal loads.
- The imported elements will be transported from the most feasible port of entry, which is deemed to be Port of Ngqura. It is expected that the inverter will be imported and shipped.
- All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads.
- Material for the construction of internal access roads will be sourced locally as far as possible.

1.1.5. Source of Information

Information used in a transport study includes:

- Project Information and report template provided by the Client
- Google Earth .kmz provided by the Client
- Google Earth Satellite Imagery

1.2. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Legal requirements pertaining to the proposed WEF are:

- Applicable import permits for the turbine components.
- Abnormal load permits are required for vehicles exceeding the permissible maximum dimensions on road freight transport in terms of the Road Safety Act (Act No. 93 of 1996). A permit is required for each Province that the haulage route traverses.
- Atmospheric Emissions License and Waste Management License required for construction phase for dust and waste generated by construction vehicles.*
- Permit will be required if any trees are to be removed during the construction of new roads or widening of existing roads.*

* These studies are covered by other consultants but have been mentioned since the permits and licenses are required due to transport/traffic related activities.

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1. Description of the site

The proposed Phase 2 Kuruman WEF will be located south-west of Kuruman, approximately 34km east of Kathu in the Northern Cape and comprises two farms, as shown in **Figure 1**.

Figure 1: Aerial View of Proposed Phase 2 Kuruman WEF

The proposed WEF will accommodate 52 wind turbines with a generation capacity of 4.5 megawatts (MW) per turbine. It should be noted that the exact locations of the 52 turbines have not been finalised. Turbine corridors have been provided as an indication of the proposed locations of the turbines.

The infrastructure associated with this facility includes:

- A total of 52 wind turbines with a generating capacity of 4.5MW per turbine;
- 3 construction yards of 200m x 100m = 2 ha;
- Roads connecting turbines will be constructed at 8m wide and existing roads will be widened to 8m;
- Collector substation;
- 33kV underground lines; and
- Supporting electrical infrastructure (Eskom metering station, transmission lines and Eskom Substation)

1.3.2. National Route to Site

The most suitable port is the Port of Ngqura, which is located 1057 km travel distance from the site. This Port is a deep-water port geared for handling large container ships and has large laydown areas available for storage of wind turbine components.

The preferred route for abnormal load vehicles will be from the port, heading north on the N10 to Britstown (passing Middelburg) and onto the N12 towards Kimberley. At Kimberly, the abnormal load vehicle will travel on the R31 to Barkly West. Due to geometric constraints at Barkly West, the abnormal load vehicle will take the R374, R371 and R370 gravel roads as a detour, which will connect the abnormal load vehicle to the R31. At Danielskuil, the abnormal vehicle will head north to Kuruman.

It is critical to ensure that the abnormal load vehicle will be able to move safely and without obstruction along the preferred routes. The preferred route should be surveyed to identify problem areas e.g. intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification. After the road modifications have been implemented, it is recommended to undertake a “dry-run” with the largest abnormal load vehicle, prior to the transportation of any turbine components, to ensure that the delivery of the turbines will occur without disruptions.

It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.

Figure 2: Preferred route from Port of Entry to the proposed WEF

1.3.3. Main Route for the Transportation of the Wind Turbine Components

The investigation showed that it will be possible to transport the imported wind turbine components by road to the proposed sites. The proposed main route will be along the R31 (Voortrekker Road) and the N14 (Hoof Street). The proposed WEF site can be accessed via the gravel road D3420, located east of the site and accessed via the R31 to the east of the site and the partially surfaced road D3441, located to the west of the site and accessed via the N14. The access roads are shown in **Figure 3** below.

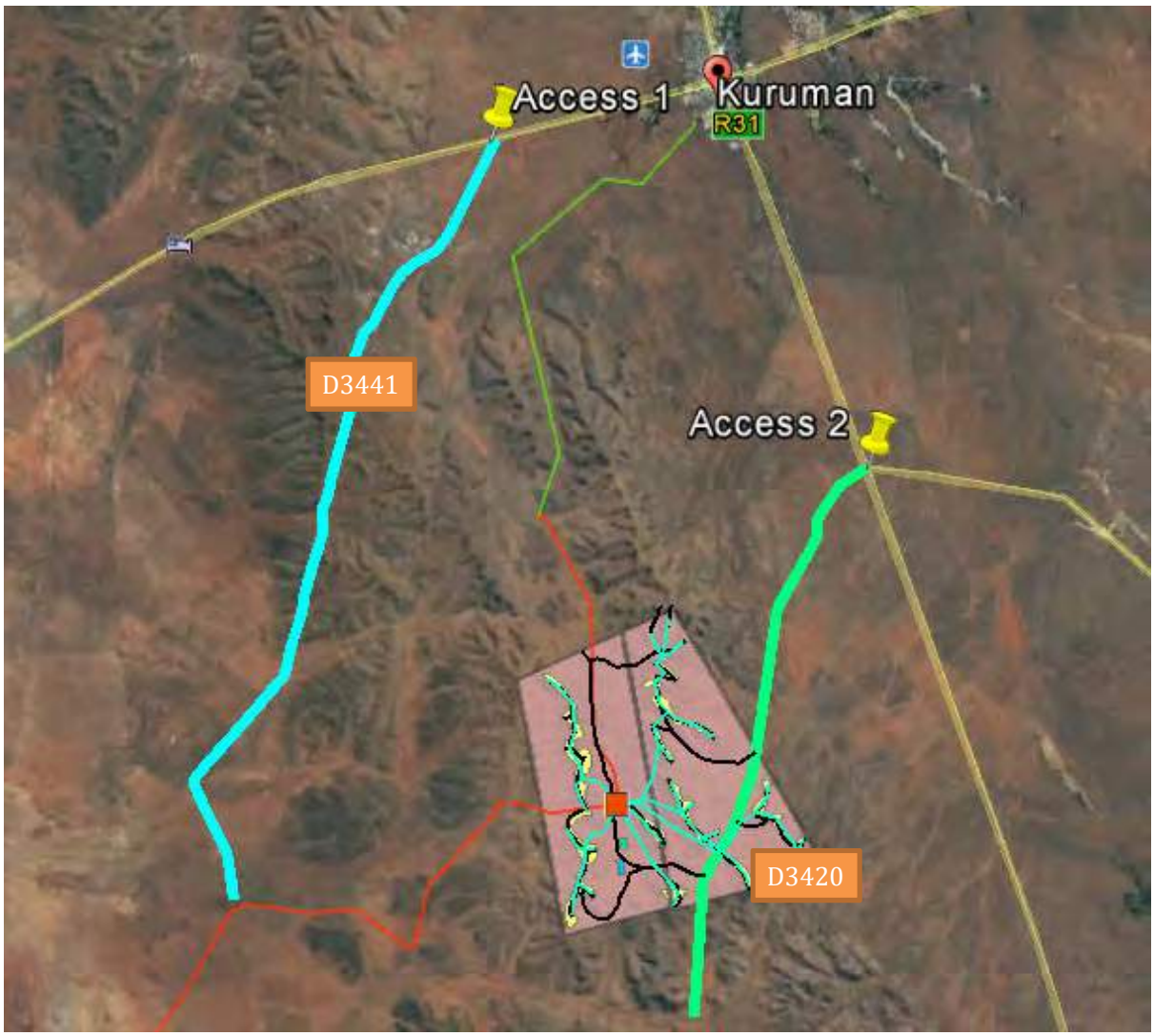

Figure 3: Access roads

1.3.4. Proposed main access road to the proposed WEF

For Phase 2 of the proposed Kuruman WEF, access will be provided via the D3420. The proposed turbine and internal road layout indicates that the main access road to the WEF will be constructed from the D3420, approximately 12.5km from the R31. The layout also indicates that a concrete tower plant and a construction yard will be constructed on the main access road to the WEF.

Figure 4: D3420

During the site visit, the proposed WEF site was accessed via D3420. The existing gravels roads within the proposed WEF site are narrow and have not been maintained. These gravel roads will be widened to form part of the internal roads of the proposed WEF.

Figure 5: Main access to Phase 2 WEF via D3420

Figure 6: Existing gravel roads in the Phase 2 area

Figure 7: Existing gravel roads in the Phase 2 area

It should be noted that there are additional existing gravel roads located further south off D3441. These existing gravel roads could be further investigated as alternative accesses to the proposed Phase 2 site should the proposed main access (located off D3420) not be a feasible option.

An additional option for access to the Phase 2 area would be via gravel road D3441. For Phase 1 of the Kuruman WEF, the proposed main access road is located off D3441. This main access road connects to the main access road of Phase 2 on the boundary of the two phases. Turbines could therefore be delivered to the Phase 2 area via the proposed main access road of Phase 1. This option, however, is dependent on the approval of Phase 2 in conjunction with Phase 1.

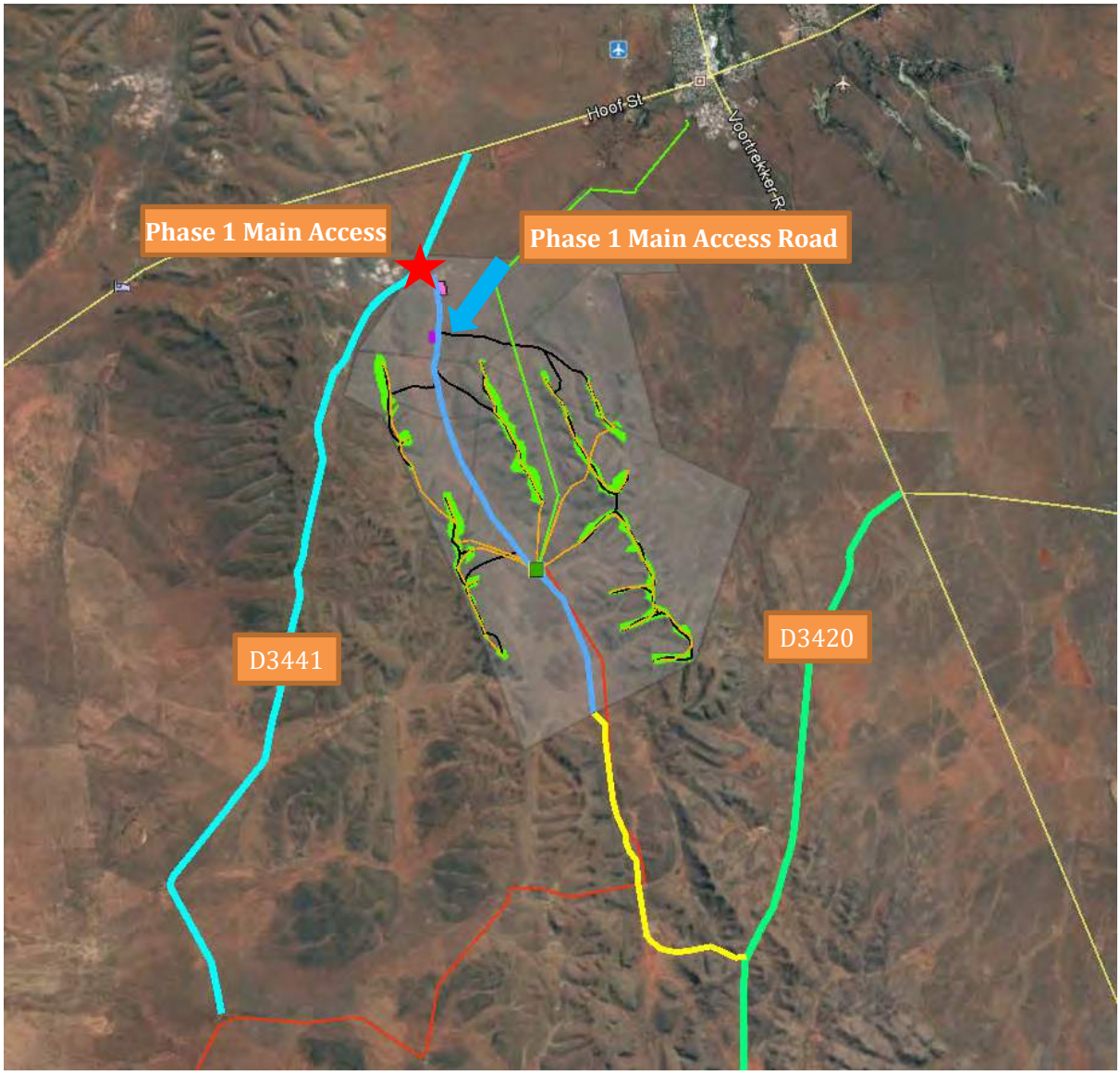

Figure 4: Access via Phase 1 proposed main access

A minimum required road width of 4 metres needs to be kept and all turning radii must conform with the specifications needed for the abnormal load vehicles and haulage vehicles. It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will hence need to be maintained during the additional loading of the construction phase and then reinstated after construction finishes. The gravel roads will require grading with a road grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. Geometric design constraints might be encountered due to the rolling, hilly topography of the area, as shown in the photographs below. The road designer should take cognizance that the turbines are to be positioned at the top of the hills, therefore roads need to be designed with smooth, relatively flat gradients to allow an abnormal load vehicle to ascend to the top of the hill.

Figure 8: Hills at Phase 2 site

It should be noted that Eskom lines along the gravel road will have to be moved to accommodate the abnormal load vehicles.

1.3.5. Main Route for the Transportation of Materials, Plant and People to the proposed WEF

The nearest towns in relation to the proposed WEF sites are Kuruman and Kathu. Kuruman is situated within 20km from the WEF and Kathu 40km. The main routes linking Kuruman and Kathu to the proposed WEF is the N14 and the R31. It is envisaged that the majority of materials, plant and labour will be sourced from these towns and transported to the WEF via the N14 and R31.

Existing concrete batch plants and quarries are situated in Kuruman and Kathu. If these businesses were contracted to supply materials and concrete, the impact on the traffic would be reduced due to their proximity to the proposed WEF site. Alternatively, mobile concrete batch plants and temporary construction material stockpile yards could be commissioned on vacant land near the proposed WEF site. Delivery of materials to the mobile batch plant and the stockpile yard could be staggered to minimise traffic disruptions.

It is envisaged that most materials, water, plant, services and labour will be procured within a 60km radius from the proposed WEF.

1.4. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE TRANSPORT STUDY

1.4.1. Port of Entry

It is assumed that the wind turbine components will be imported to South Africa via the Port of Ngqura. The Port of Ngqura is a world class deep water transhipment hub offering an integrated, efficient and competitive port service for containers on transit. The Port forms part of the Coega Industrial Development Zone and is operated by Transnet National Ports Authority.

The Port also services the industrial bulk commodity requirements of the regional and national hinterland. Containers handled include imports and exports from across the globe as well as trans-shipment cargoes serving primarily East and West coast traffic as well as inter-line traffic from South America to Asia.

1.4.2. Selected Candidate Turbine

The possible range of wind turbines varies largely with various wind turbine manufacturers operating worldwide. The project information states that a turbine with a hub height of 140m and a blade length of 80m is to be considered.

In general, each turbine unit consists of a tower, a Nacelle (final weight dependent on the supplier and whether the nacelle has gears or not) and rotor blades.

It is assumed that all turbine parts will be imported and shipped via the Ngqura Port.

1.4.3. Transportation requirements

1.4.3.1. Abnormal Load Considerations

Abnormal permits are required for vehicles exceeding the following permissible maximum dimensions on road freight transport in terms of the Road Safety Act (Act No. 93 of 1996):

- Length: 22m for an interlink, 18.5m for truck and trailer and 13.5m for a single unit truck
- Width: 2.6m
- Height: 4.3m measured from the ground. Possible height of load – 2.7m.
- Weight: Gross vehicle mass of 56t resulting in a payload of approximately 30t
- Axle unit limitations: 18t for dual and 24t for triple-axle units
- Axle load limitation: 7.7t on front axle and 9t on single or rear axles

Any dimension / mass outside the above will be classified as an Abnormal Load and will necessitate an application to the Department of Transport and Public Works for a permit that will give authorisation for the conveyance of said load. A permit is required for each Province that the haulage route traverses.

1.4.3.1.1. Further Guideline Documentation

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” outlines the rules and conditions that 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 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 Road Traffic Act and the relevant regulations.

1.4.3.1.2. Permitting – General Rules

The limits recommended in TRH 11 are intended to serve as a guide to the Permit Issuing Authorities. It must be noted that each Administration has the right to refuse a permit application or to modify the conditions under which a permit is granted. It is understood that:

a) A permit is issued at the sole discretion of the Issuing Authority. The permit may be refused because of the condition of the road, the culverts and bridges, the nature of other traffic on the road, abnormally heavy traffic during certain periods or for any other reason.
b) A permit can be withdrawn if the vehicle upon inspection is found in any way not fit to be operated.
c) During certain periods, such as school holidays or long weekends an embargo may be placed on the issuing or permits. Embargo lists are compiled annually and are obtainable from the Issuing Authorities.

1.4.3.1.3. Load Limitations

The maximum load that a road vehicle or combination of vehicles will be allowed to carry legally under permit on a public road is limited by:

- the capacity of the vehicles as rated by the manufacturer;
- the load which may be carried by the tyres;
- the damaging effect on pavements;
- the structural capacity on bridges and culverts;
- the power of the prime mover(s);
- the load imposed by the driving axles and
- the load imposed by the steering axles.

1.4.3.1.4. Dimensional Limitations

A load of abnormal dimensions may cause an obstruction and danger to other traffic. For this reason, all loads must, as far as possible, conform to the legal dimensions. Permits will only be considered for indivisible loads, i.e. loads that cannot, without disproportionate effort, expense or risk of damage, be divided into two or more loads for the purpose of transport on public roads. For each of the characteristics below there is a legally permissible limit and what is allowed under permit.

- Width
- Height
- Length
- Front Overhang
- Rear Overhang
- Front Load Projection
- Rear Load Projection
- Wheelbase
- Turning Radius
- Stability of Loaded Vehicles

1.4.3.2. Transporting Wind Turbine Components

Wind turbine components can be transported in a number of ways with different truck / trailer combinations and configurations, which will need to be investigated at a later stage when the transporting contractor and the plant hire companies apply for the necessary permits from the Permit Issuing Authorities.

1.4.3.2.1. Nacelle

The heaviest component of a wind turbine is the Nacelle (approximately 100 tons depending on manufacturer and design of the unit). Combined with road based transport, it has a total vehicle mass of approximately 145 000kg for a 100-ton unit. Thus, route clearances and permits will be required for transporting the Nacelle by road based transport (see example of a road based transport below). The unit will require a minimum height clearance of 5.1metres.

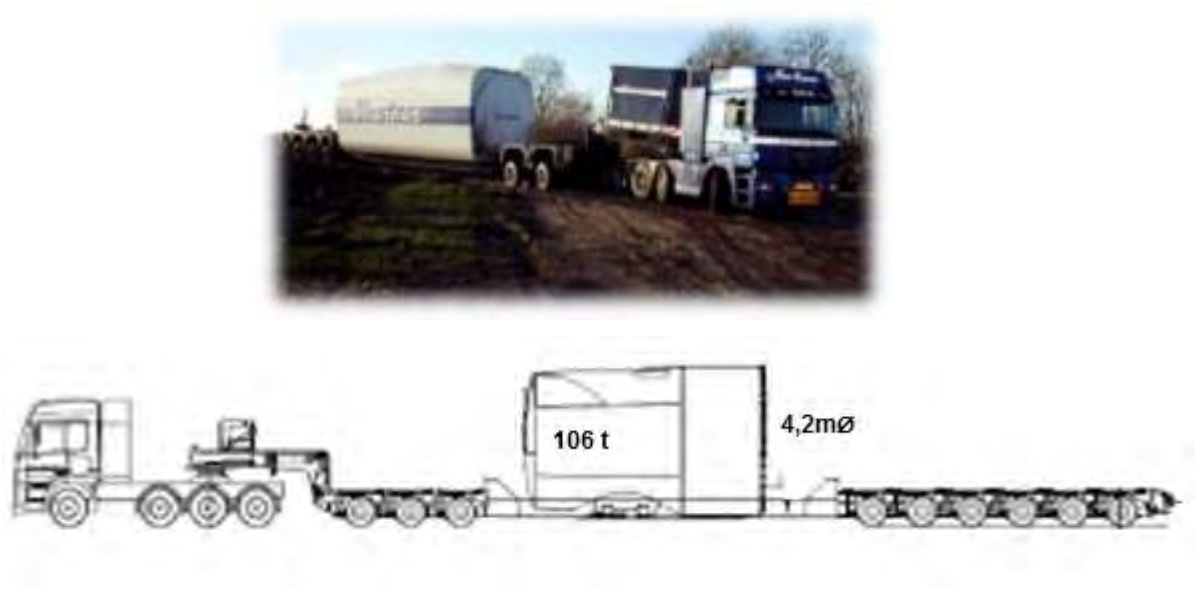

Figure 9: Transporting the Nacelle

1.4.3.2.2. Blades

These are the longest and possibly most vulnerable components of a wind turbine and hence needs to be transported with upmost care. The set of three blades are 80m in length each and they need to be transported on an extendible blade transport trailer or in a rigid container with rear steerable dollies. The blades can be transported individually, in pairs or in three's; although different manufacturers have different methods of packaging and transporting the blades. The transport vehicle exceeds the dimensional limitation (length) of 22m and will only be allowed under permit, provided the trailer is fitted with steerable rear axles or dollies.

Figure 10: Example: 3 x 45m Blades on extendible trailers

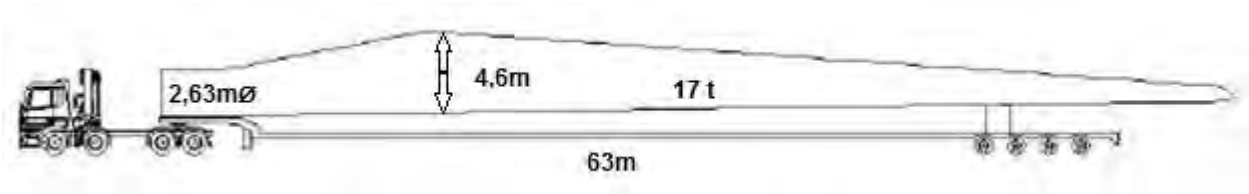

Figure 11: Example of Blade Transport

Turbine blades of 80m in length have been proposed. Due to this abnormal length, special attention needs to be given to the route planning, especially to suitable turning radii and adequate sweep clearance. Therefore, vegetation or road signage may have to be removed before transport.

Once transported to site, the blades need to be carefully stored in their respective laydown areas before being installed onto the rotary hub.

1.4.3.2.3. Tower Sections

Tower sections generally consist of sections of around 20 metres in length and hence the number of tower sections required depends on the selected hub height. For a hub height of 140 metres, it is assumed that seven tower sections are required. Each section is transported separately on a low-bed trailer. Depending on the trailer configuration and height when loaded, some of these components may not meet the dimensional limitations (height and width), but will be permitted under certain permit conditions (see examples below).

Figure 12: Transporting the Tower Sections

1.4.3.2.4. Turbine Hub and Rotary Units

These components need to be transported separately, due to their significant weights - a hub unit weighs around 45 tons and the rotary unit weighs over 90 tons.

Figure 13: Transporting the Hub and Rotary Units

1.4.3.3. Transporting Cranes, Mobile Crane and other Components

This technology has developed fairly rapidly, and a number of different heavy lifting options are available on the market. Costs involved to hire cranes vary and hence should be compared beforehand. For the purpose of this assessment, some possible crane options are outlined as follows.

1.4.3.3.1. Cranes for Assembly and Erection on Site

Option 1: Crawler Crane & Assembly Crane
One possible option is that the main lift crane that would be capable of performing the required lifts, i.e. lifting the tower sections into position, lifting the Nacelle to the hub height and lifting the Rotor and Blades into place, needs to be similar to the Liebherr Crawler Crane LR1750 with a SL8HS (Main Boom and Auxiliary Jib) configuration. A smaller 200-ton Liebherr Mobile Crane LTM 1200-5.1 is also required to lift the components and assist in the assembly of the crawler crane at each turbine location.

- **Crawler Crane LR1750 with the SL8HS boom system (Main Lifting Crane):**

The Crawler Crane will be transported to site in components and the heaviest load will be the superstructure and crawler centre section (83 tons). The gross combination mass (truck, trailer and load) will be approximately 133 000 kg. The boom sections, counterweights and other equipment will be transported on conventional tri-axle trailers and then assembled on site. It will require a number of truckloads of components to be delivered for assembly of the Crawler Crane before it can be mobilised to perform the heavy lifts.

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

The Liebherr LTM 1200-5.1 crane is a 5-axle vehicle with rubber tyres, which will travel to site on its own. However, the counterweights will be transported on conventional tri-axle trailers and then assembled on site. The assembly crane is required to assemble the main lift crane as well as assist in the installation of the wind turbine components.

Option 2: GTK 1100 Crane & Assembly Crane

For the single wind turbine at Coega, the GTK 1100 hydraulic crane was used (see example in picture below). The GTK 1100 was designed to lift ultra-heavy loads to extreme heights and its potential lies in being deployed on facilities such as wind turbine farms.

Figure 14: Cranes at work

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

As above - a smaller 200-ton Liebherr Mobile Crane LTM 1200-5.1 is also required to lift the components and assist in the assembly of the hydraulic crane at each turbine location.

1.4.3.3.2. Cranes at Port of Entry

Most shipping vessels importing the turbine components will be equipped with on-board cranes to do all the safe off-loading of WTG components to the abnormal transport vehicles, parked adjacent to the shipping vessels.

Figure 15: Cranes at Port of Entry

The imported turbine components may be transported from the Port of Entry to the nearby turbine laydown area. Mobile cranes will be required at these turbine laydown areas to position the respective components at their temporary storage location.

1.4.3.4. Transporting Other Plant, Material and Equipment

In addition to transporting the specialised lifting equipment, the normal Civil Engineering construction materials, plant and equipment will need to be brought to the site (e.g. sand, stone, cement, concrete

batching plant, gravel for road building purposes, excavators, trucks, graders, compaction equipment, cement mixers, transformers in the sub-station, cabling, transmission pylons etc.). Other components, such as electrical cables, pylons and substation transformers will also be transported to site during construction. The transport of these items will generally be conducted with normal heavy loads vehicles.

1.5. IDENTIFICATION OF IMPACTS

1.5.1. Identification of Potential Impacts

The potential transport related impacts are described below.

1.5.2. Construction Phase

- *Potential impact 1*
  Construction related traffic including transportation of people, construction materials, water and equipment to the site (Abnormal trucks delivering turbine components to the site).

  This phase also includes the construction of roads, excavations of turbine footings, trenching for electrical cables and other ancillary construction works that will temporarily generate the most traffic.

1.5.3. Operational Phase

During operation, it is expected that staff and security will periodically visit the turbines. It is assumed that approximately five full-time employees will be stationed on site. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.

1.5.4. Decommissioning Phase

- *Potential Impact 2*
  Construction related traffic including transportation of people, construction materials, water and equipment (Abnormal trucks transporting turbine components).

1.5.5. Cumulative impacts

- Traffic congestion/delays on the surrounding road network.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.6.1. Potential Impact 1 (Construction Phase)

- *Nature of the impact*
  Potential traffic congestion and delays on the surrounding road network.

- *Significance of impact without mitigation measures*
  Traffic generated by the construction of the WEF will have a significant impact on the surrounding road network. The exact number of trips generated during construction will be determined by the haulage company transporting the components to site.

  For the transportation of the turbines to the WEF site, it was assumed that the turbine blades will be transported separately to site. Consequently, for each wind turbine three abnormal loads will be required for the blades, seven abnormal loads for the tower sections and another abnormal load for the nacelle. All further components will be transported with normal

limitations haulage vehicles. With approximately 11 abnormal load trips, the total trips to deliver the components of 52 turbines to the WEF site will be around 572 trips.

The constructions of roads and concrete footings will also have a significant impact on the surrounding road network as vehicles deliver materials to the site. A concrete footing (approximately 500m^3) adds over 80 trips by concrete trucks to the surrounding road network.

The significance of the transport impact without mitigation measures during the construction phase can be rated as substantial.

- *Proposed mitigation measures*
    - The delivery of wind turbine components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
    - Reduce the construction period
    - Stagger the construction of the turbines
    - The use of mobile batch plants and quarries in close proximity to the site would decrease the impact on the surrounding road network.
    - Staff and general trips should occur outside of peak traffic periods.

- *Significance of impact with mitigation measures*
  The proposed mitigation measures will result in a minor reduction of the impact on the surrounding road network, but the impact on the local traffic will remain moderate to high.

1.6.2. Potential Impact 2 (Decommissioning Phase)

- This phase will result in the same impact as the Construction Phase as similar trips are expected.

1.6.3. Cumulative Impacts

The construction and decommissioning phases of a WEF are the only traffic generators. The duration of these phases is short term i.e. the impact of the WEF traffic on the surrounding road network is temporary and WEFs, when operational, do not add any significant traffic to the road network.

1.7. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above a collated in Error! Reference source not found. to Error! Reference source not found. below.

Table 1-1 Impact assessment summary table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction Activities	Traffic congestion and delays	Negative	Regional	Short term	Substantial	Very likely	High	-	- Stagger turbine component delivery to site - Reduce the construction period - Stagger the construction of the turbines - The use of mobile batch plants and quarries in close proximity to the site would decrease the impact on the surrounding road network. - Staff and general trips should occur outside of peak traffic periods	Substantial	Moderate	3	Medium

Table 1-2 Impact assessment summary table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
The traffic generated during this phase will be minimal and will have a nominal impact on the surrounding road network.													

Table 1-3 Impact assessment summary table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Construction Activities	Traffic congestion and delays	Negative	Regional	Short term	Substantial	Very likely	High	-	- Stagger turbine component transportation - Reduce the construction period - Stagger the construction of the turbines - Staff and general trips should occur outside of peak traffic periods	Substantial	Moderate	3	Medium

Table 1-4 Cumulative impact assessment summary table

Cumulative Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Con-struction Activities	Traffic congestion and delays	Negative	Regional	Short term	Substantial	Very likely	High	-	- Stagger turbine component transportation - Reduce the construction period - Stagger the construction of the turbines - Staff and general trips should occur outside of peak traffic periods	Substantial	Moderate	3	Medium

1.8. REFERENCES

- Google Earth Pro
- SANS 10280/NRS 041-1:2008 - Overhead Power Lines for Conditions Prevailing in South Africa
- Road Safety 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