Perdekraal West Wind Farm (Pty) Ltd

COMPARATIVE NOISE IMPACT ASSESSMENT

for the

Amendment of the Environmental Authorisation for the Proposed Establishment of the Perdekraal West Wind Energy Facility North of Touws River, Western Cape

Study done for:

savannah environmental

Prepared by:

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EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Enviro Acoustic Research cc conducted an Environmental Noise Impact Assessment (ENIA) during 2014 (report ERM-PWEF/ENIA/201407-Rev 0) for the proposed Perdekraal Wind Energy Facility (WEF). The Perdekraal Wind Energy Facility (WEF) was purchased by BioTherm Energy (Pty) Ltd with Environmental Authorization (EA) granted in December 2012 (DEA Ref: 12/12/20/1783/1). The project will be developed as the Perdekraal West Wind Farm (Pty) Ltd (a Special Purpose Vehicle) by the owners BioTherm Energy and Genesis Eco-Energy. The original WEF was thereafter amended by splitting the original Perdekraal WEF into two separate wind farms, namely Perdekraal West WEF and Perdekraal East WEF.. The focus of this ENIA is the Perdekraal West WEF.

Perdekraal West Wind Farm (Pty) Ltd is proposing to amend the turbine specifications and layout for the Perdekraal West WEF, and it was requested to review the potential change in the noise impact and whether it would result in a change in the findings and recommendations of the previous ENIA.

Enviro-Acoustic Research (EARES) was consequently contracted by Savannah Environmental (Pty) Ltd (the EAP) to do a comparative noise impact assessment on the surrounding environment as a result of the currently proposed amendments to the Perdekraal West WEF.

PROJECT DESCRIPTION

Perdekraal West Wind Farm (Pty) Ltd is proposing to amend the EA for the proposed Perdekraal West WEF near Touws River in the Western Cape Province. The proposal is to amend the wind turbine specifications as follows:

- Increase rotor diameter from 120m, up to 155m
- Hub height up to 120m
- Blade tip height up to 198m
- Increase wind turbine generation capacity from 1.5MW to 6MW
- Decrease the number of wind turbines from 60-65 to a maximum of 47.

For the purpose of this noise assessment, the sound power emission levels of the Goldwind GW140/3S wind turbine generator (WTG) were used as this represents a typical large rotor turbine. The 2014 noise study made use of the sound power emission levels of the Acciona AW125/3000 WTG. These two WTGs (as evaluated) have a similar sound power emission level.

BASELINE ASSESSMENT

Ambient sound levels were measured at a number of locations from 26 to 28 September 2016 for a different project (the Karee and Kolkies WEFs) within 10 – 20 km from the proposed project site. The data is fully applicable to the project site. Four class-1 Sound Level Meters were used for these measurements. Three instruments were used for semi-continuous, longer measurements (2 night-time periods) with one instrument used for shorter measurements (10 minutes each). The sound level meters would measure "average" sound levels over a time period, save the data and start with a new measurement until the instrument was stopped. The long-term measurement locations were selected to be reflective of the typical environmental ambient sound levels that a receptor may experience in the area.

Daytime measured data indicate an area with elevated noise levels, but considering the spectral data and sounds heard, these sounds are mainly due to natural activities (wind-induced). Night-time measurements indicated a very quiet environment, even with low winds (around 0 – 2 m/s). Considering the measurements and measurements conducted in the last few years at similar areas, acceptable rating levels for the area would be typical of a rural noise district. For the purpose of this comparative impact study, the strictest rating level (rural) will be used as defined in SANS 10103:2008 (35 dBA at night, 45 dBA during the day) for all the potential noise-sensitive developments living in the area.

NOISE IMPACT FINDINGS

This comparative impact study used the sound power emission levels of the Goldwind GW140/3S WTG, together with the octave sound power emission levels of the Acciona AW125/3000 WTG. The spectral data from the Acciona was used, as using a sound power emission level alone could result in an over-estimated noise rating level.

Various construction activities would typically take place during the development of the facility, and may pose a noise risk to the closest receptors. The resulting future noise projections indicated that the construction activities of the wind turbines, as modelled for the conceptual scenario, will comply with the provincial Noise Control Regulations for construction and operational activities.

Therefore, this comparative noise impact assessment concludes that the potential noise impact would remain to be of a **low** significance during the construction and operational phase.

ADVANTAGES AND DISADVANTAGES OF THE AMENDMENT

The proposed renewable power generation activities (worse-case evaluated) will very slightly raise the noise levels at a number of the closest potential noise-sensitive developments. There is no alternative location where the wind farm can be developed as the presence of a viable wind resource determines the viability of a commercial WEF. While the location cannot be moved, the wind turbines within the WEF can be moved around, with this layout being the result of numerous evaluations and modelling to identify the most economically feasible and environmentally friendly layout.

The project will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa and locally. The project will generate short and long-term employment and other business opportunities and promote renewable energy in South Africa and locally. People in the area that are not directly affected by increased noises generally have a more positive perception of the renewable projects and understand the need and desirability of the project.

The projected noise levels of this amendment will be similar to the noise levels previously modelled, and in terms of acoustics, there is no particular advantages or disadvantages with this amendment.

RECOMMENDATIONS AND CONCLUSIONS

Considering the modelled construction and operational noise levels, the proposed changes to the wind turbines (and minor layout changes) will not lead to any other noise impacts, neither will it change the significance of the noise impact as defined in the original reports. The findings and recommendations highlighted in the 2014 report would remain. Considering the possible **low** significance of the potential noise impact, the proposed amendment of the Perdekraal West WEF can be authorised from a noise perspective.

This report should be sited as:

De Jager, M. (2018): "Comparative *Noise Impact Assessment for the Establishment of the Perdekraal West Wind Energy Facility North of Touws River, Western Cape*". Enviro-Acoustic Research CC, Pretoria

Client:

Savannah Environmental (Pty) Ltd for
Perdekraal West Wind Farm (Pty) Ltd

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GLOSSARY OF ABBREVIATIONS

DEA	Department of Environmental Affairs
DoE	Department of Energy
EA	Environmental Authorisation
EARES	Enviro Acoustic Research cc
FEL	Front end loader
hh	Hub height
i.e.	that is
i.t.o	In terms of
IFC	International Finance Corporation
km	kilometres (measurement of distance)
LDV	Light delivery vehicle
m	meters (measurement of distance)
mamsl	Meters above mean sea level
m/s	meters per second
MW	Megawatt
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NCR	Noise Control Regulations (under Section 25 of the ECA)
PPA	Power Purchase Agreement
SANS	South African National Standards (from South African Bureau of Standards)
TLB	Tip load bucket (also called a Bucket loader)
ToR	Terms of Reference
UTM	Universal Transverse Mercator
WHO	World Health Organisation
WEF	Wind Energy Facility
WTG	Wind Turbine Generators

1 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 10 years, and was involved with the following projects in the last few years:

Wind Energy Facilities	*Full Environmental Noise Impact Assessments for more than 90 different projects, including: Bannf (Vidigenix), iNCa Gouda (Aurecon SA), Isivunguvungu (Aurecon), De Aar (Aurecon), Kokerboom 1 (Aurecon), Kokerboom 2 (Aurecon), Kokerboom 3 (Aurecon), Kangnas (Aurecon), Plateau East and West (Aurecon), Wolf (Aurecon), Outeniqwa (Aurecon), Umsinde Emoyeni (ARCUS) , Komsberg (ARCUS), Karee (ARCUS), Kolkies (ARCUS), San Kraal (ARCUS), Phezukomoya (ARCUS), Canyon Springs (Canyon Springs), Perdekraal (ERM), Scarlet Ibis (CESNET), Albany (CESNET), Sutherland (CSIR), Kap Vley (CSIR), Kuruman (CSIR), Rietrug (CSIR), Sutherland 2 (CSIR), Perdekraal (ERM), Teekloof (Mainstream), Eskom Aberdene (SE), Dorper (SE), Spreeukloof (SE), Loperberg (SE), Penhoek Pass (SE), Amakhala Emoyeni (SE), 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), Deep River (SE), Tsitsikamma (SE), AB (SE), West Coast One (SE), Hopefield II (SE), Namakwa Sands (SE), VentuSA Gouda (SE), Dorper (SE), Klipheuwel (SE), INCA Swellendam (SE), Cookhouse (SE), Cookhouse II (SE), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Koningaas (SE), Spitskop (SE), Castle (SE), Khai Ma (SE), Poortjies (SE), Korana (SE), IE Moorreesburg (SE), Gunstfontein (SE), Namas (SE), Vredenburg (Terramanzi), Loeriesfontein*

	(SiVEST), Rhenosterberg (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Dwarsrug (SiVEST), Graskoppies (SiVEST), Philco (SiVEST), Hartebeest Leegte (SiVEST), Ithemba (SiVEST), !Xha Boom (SiVEST), Spitskop West (Terramanzi), Haga Haga (Terramanzi), Vredenburg (Terramanzi), Msenge Emoyeni (Windlab)
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)*

2 INTRODUCTION

2.1 INTRODUCTION AND PURPOSE

Enviro Acoustic Research cc conducted an Environmental Noise Impact Assessment (ENIA) during 2014 (report ERM-PWEF/ENIA/201407-Rev 0) for the proposed Perdekraal Wind Energy Facility (WEF). The Perdekraal Wind Energy Facility (WEF) was purchased by BioTherm Energy (Pty) Ltd with Environmental Authorization (EA) granted in December 2012 (DEA Ref: 12/12/20/1783/1). The project will be developed as the Perdekraal West Wind Farm (Pty) Ltd (a Special Purpose Vehicle) by the owners BioTherm Energy and Genesis Eco-Energy. The original WEF was thereafter amended by splitting the original Perdekraal WEF into two separate wind farms, namely Perdekraal West WEF and Perdekraal East WEF (proposed by Mainstream Renewable Power South Africa (Pty) Ltd). The focus of this ENIA is the Perdekraal West WEF.

The developer is proposing to amend the turbine specifications and layout for the Perdekraal West WEF, and it was requested to review the potential change in the noise impact and whether it would result in a change in the findings and recommendations of the previous ENIA.

Enviro-Acoustic Research (EARES) was consequently contracted by Savannah Environmental (Pty) Ltd (the EAP) to do a comparative noise impact assessment on the surrounding environment as a result of the currently proposed amendments to the Perdekraal West WEF.

Therefore, this comparative impact assessment should be read with reports ERM-PWEF/ENIA/201407-Rev 0 (dated July 2014) and ERM-PWEF/ENIA/201607-Rev 4 (2016) (dated October 2016). It should be noted that the previous reports were compiled for ERM, using different Impact Assessment criteria. The significance of the noise impact from the previous layouts was determined to be low. As the Impact Assessment criteria is different from the Impact Assessment criteria used in this report, a direct comparative assessment is not possible.

2.2 BRIEF PROJECT DESCRIPTION

Perdekraal West Wind Farm (Pty) Ltd is proposing to amend the EA for the proposed Perdekraal West WEF near Touws River in the Western Cape Province. The proposal is to amend the wind turbine specifications as follows:

- Increase rotor diameter from 120m, up to 155m

- Hub height up to 120m
- Blade tip height up to 198m
- Increase wind turbine generation capacity from 1.5MW to 6MW
- Decrease the number of wind turbines from 60-65 to a maximum of 47.

For the purpose of this noise comparative impact assessment, the sound power emission levels of the Goldwind GW140/3S wind turbine generator (WTG) were used. The 2014 noise study made use of the sound power emission levels of the Acciona AW125/3000 WTG. The 2016 noise study made use of the sound power emission levels of the Siemens SWT 2.346-108 WTG. These three WTGs (as evaluated) have similar sound power emission levels.

2.3 STUDY AREA

The proposed Perdekraal West WEF and its grid connection will be located in the Witzenberg Local Municipality.

2.3.1 Topography

The Perdekraal West WEF is proposed to be developed on a relatively flat area.

2.3.2 Land use

Land use in the area is mostly wilderness (ecotourism) and agricultural activities (sheep and game).

2.3.3 Ground conditions and vegetation

The area falls in the Succulant Karoo biome. The surface area is generally uneven with low growing and sparse vegetation. A 25% ground attenuation factor for the noise propagation model was selected based on sparse vegetation conditions, as ground conditions are unlikely to assist in the attenuation of noise (fraction of sound waves hitting and being reflected from the ground).

2.3.4 Existing Ambient Sound Levels

Considering the developmental character as well as ambient sound level measurements collected in the area, ambient sound levels would be low, typical of a rural area in the Karoo.

2.4 POTENTIAL NOISE-SENSITIVE RECEPTORS (DEVELOPMENTS) AND NO-GO AREAS

There are a few dwellings close to the proposed Perdekraal West WEF, with NSD01 identified during the previous ENIA (de Jager, 2014) (see **Figure 2-1** below). It was reported during the 2014 study that the dwelling at NSD01 is derelict and not used. The statuses of the

other dwellings are not known and were precautionary viewed as potential noise sensitive developments.

2.5 TERMS OF REFERENCE (TOR)

Enviro Acoustic Research cc conducted an ENIA during 2014 (report ERM-PWEF/ENIA/201407-Rev 0) for the proposed Perdekraal Wind Energy Facility (WEF).

This comparative noise impact study assesses the following:

- The noise impacts related to the proposed changes;
- Advantages and/or disadvantages associated with the changes;
- Comparative assessment of the impacts before and after the changes; and
- Measures to ensure avoidance, management and mitigation of impacts associated with such proposed changes as well as any changes to the EMPr.

The comparative noise impact assessment must be clear on whether the proposed changes to the EA will:

- Increase the significance of impacts originally identified in the EIA report or lead to any additional impacts; or
- Have a zero or negligible effect on the significance of impacts identified in the EIA report; or
- Lead to a reduction in any of the identified impacts in the EIA report.

Figure 2-1: Aerial image indicating a potentially noise-sensitive development and locations of WTG

3 LEGAL CONTEXT, POLICIES AND GUIDELINES

3.1 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Water and Environmental Affairs") to make regulations regarding noise, among other concerns. The Western Cape Province has promulgated noise control regulations since the 2012 and 2013 studies (see following section).

3.1.1 Western Cape Provincial Noise Control Regulations: PN 200 of 2013

The control of noise in the Western Cape is legislated in the form of the Noise Control Regulations in terms of Section 25 the Environment Conservation Act No. 73 of 1989, applicable to the Province of the Western Cape as Provincial Notice 200 of 20 June 2013.

The regulations define:
"**ambient noise**" means the all-encompassing sound in a given situation at a given time, measured as the reading on an integrated impulse sound level meter for a total period of at least 10 minutes".

"**disturbing noise**" means a noise, excluding the unamplified human voice, which—
(a) exceeds the rating level by 7 dBA;
(b) exceeds the residual noise level where the residual noise level is higher than the rating level;
(c) exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or
(d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103;

''noise sensitive activity'' means any activity that could be negatively impacted by noise, including residential, healthcare, educational or religious activities;

''low-frequency noise'' means sound which contains sound energy at frequencies predominantly below 100 Hz;

''rating level'' means the applicable outdoor equivalent continuous rating level indicated in Table 2 of SANS 10103;

"residual noise" means the all-encompassing sound in a given situation at a given time, measured as the reading on an integrated impulse sound level meter for a total period of at least 10 minutes, excluding noise alleged to be causing a noise nuisance or disturbing noise;

"sound level" means the equivalent continuous rating level as defined in SANS 10103, taking into account impulse, tone and night-time corrections;

These Regulations prohibits anyone from causing a disturbing noise (Clause 2) and uses the $L_{Aeq,impulse}$ descriptor to define ambient sound and noise levels.

Also, in terms of regulation 4:

(1) The local authority, or any other authority responsible for considering an application for a building plan approval, business licence approval, planning approval or environmental authorisation, may instruct the applicant to conduct and submit, as part of the application—

(a) a noise impact assessment in accordance with SANS 10328 to establish whether the noise impact rating of the proposed land use or activity exceeds the appropriate rating level for a particular district as indicated in SANS 10103; or

(b) where the noise level measurements cannot be determined, an assessment, to the satisfaction of the local authority, of the noise level of the proposed land use or activity.

(2) *(a)* A person may not construct, erect, upgrade, change the use of or expand any building that will house a noise-sensitive activity in a predominantly commercial or industrial area, unless he or she insulates the building sufficiently against external noise so that the sound levels inside the building will not exceed the appropriate maximum rating levels for indoor ambient noise specified in SANS 10103.

(b) The owner of a building referred to in paragraph *(a)* must inform prospective tenants or buyers in writing of the extent to which the insulation measures contemplated in that paragraph will mitigate noise impact during the normal use of the building.

(c) Paragraph *(a)* does not apply when the use of the building is not changed.

(3) Where the results of an assessment undertaken in terms of subregulation (1) indicate that the applicable noise rating levels referred to in that subregulation will likely be exceeded, or will not be exceeded but will likely exceed the existing residual noise levels by 5 dBA or more—

(a) the applicant must provide a noise management plan, clearly specifying appropriate mitigation measures to the satisfaction of the local authority, before the application is decided; and

(b) implementation of those mitigation measures may be imposed as a condition of approval of the application.

4 CURRENT ENVIRONMENTAL SOUND CHARACTER

4.1 EFFECT OF SEASON ON SOUND LEVELS

Natural sounds are 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 such as wind flowing through vegetation increasing as wind speed increase. 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 and the total vegetation surface all determine both the sound level as well as spectral characteristics.

Ambient sound levels are significantly affected by the area where the sound measurement location is situated. When the sound measurement location is situated within an urban area, close to industrial plants or areas with a constant sound source (ocean, rivers, etc.), seasons and even increased wind speeds have an insignificant to massive impact on ambient sound levels.

Sound levels in undeveloped rural areas (away from occupied dwellings) however are impacted by changes in season for a number of complex reasons. The two main reasons are:

- Faunal communication during the warmer spring and summer months as various species communicate in an effort to find mates; and
- Seasonal changes in weather patterns, mainly wind (also see **section 4.2**).

For environmental noise, weather plays an important role; the greater the separation distance, the greater the influence of the weather conditions; so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible.

Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in the following sections.

4.1.1 Effect of wind on sound propagation

Wind alters sound propagation by the mechanism of refraction; that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the source. Waves bending downward means that a listener standing downwind of the source

will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high.

Over short distances, wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e. less than 3 – 5 m/s.

4.1.2 Effect of temperature on sound propagation

On a typical sunny afternoon, air is warmest near the ground and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. In the evening, this temperature gradient will reverse, resulting in cooler temperatures near the ground. This condition, often referred to is a temperature inversion will cause sound to bend downward toward the ground and results in louder noise levels at the listener position. Like wind gradients, temperature gradients can influence sound propagation over long distances and further complicate measurements.

Generally, sound propagates better at lower temperatures (down to 10°C), and with everything being equal, a decrease in temperature from 32°C to 10°C would increase the sound level at a listener 600 m away by ±2.5 dB (at 1,000 Hz).

4.1.3 Effect of humidity on sound propagation

The effect of humidity on sound propagation is quite complex, but effectively relates how increased humidity changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at high humidity. With everything being equal, an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz).

4.2 EFFECT OF WIND SPEEDS ON VEGETATION AND SOUND LEVELS

Wind speed is a determining factor for sound levels at most rural locations. With no wind, there is little vegetation movement that could generate noises, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on the type of vegetation in a certain area. The impact of increased wind speeds on sound levels depends on the vegetation type (deciduous versus connivers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes the effect of faunal communication as vegetation may create suitable habitats and food sources.

4.3 INFLUENCE OF WIND ON NOISE LIMITS

Current local regulations and standards do not consider changing ambient (background) sound levels due to natural events such as can be found near the coast or areas where wind-induced noises are prevalent. This is unfeasible with wind energy facilities as these facilities will only operate when the wind is blowing. It is therefore important that the contribution of wind-induced noises be considered when determining the potential noise impact from such a facility. Care should be taken when taking this approach due to other factors that complicate noise propagation from wind turbines.

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

Low frequency noises can also be associated with some wind turbines. Separating the potential low frequency noise from wind turbines from that generated by natural sources as well as other anthropogenic sources can and will be a challenge.

There are a number of factors that determine how ambient sound levels close to a dwelling (or the low-frequency noise levels inside the house) might differ from the ambient sound levels further away (or even at another dwelling in the area), including:

- Type of activities taking place in the vicinity of the dwelling;
- Equipment being used near the dwelling, especially equipment such as water pumps, compressors and air conditioners;
- Whether there are any windmills (*"windpompe"*) close to the dwelling as well as their general maintenance condition;
- Type of trees around dwelling (conifers vs. broad-leaved trees, habitat that it provides to birds, food that it may provide to birds);
- The number, type and distance between the dwelling (measuring point) and trees. This is especially relevant when the trees are directly against the house (where the branches can touch the roof);
- Distance to large infrastructural developments, including roads, railroads and even large diameter pipelines;
- Distances to other noise sources, whether anthropogenic or natural (such as the ocean or running water);
- The material used in the construction of the dwelling;
- The design of the building, including layout and number of openings;
- How well the dwelling is maintained; and

- The type and how many farm animals are in the vicinity of the dwelling.

4.4 AMBIENT SOUND MEASUREMENTS

Ambient sound levels were measured at a number of locations from 26 to 28 September 2016 for a different project (the Karee and Kolkies WEFs) within 10 – 20 km from this project. This data is applicable to this project site, as the developmental character, climate, vegetation and land use is the same. Four class-1 Sound Level Meters were used for these measurements. Three instruments were used for semi-continuous, longer measurements (2 night-time periods) with one instrument used for shorter measurements (10 minutes each). The sound level meters would measure "average" sound levels over a time period, save the data and start with a new measurement till the instrument was stopped. The long-term measurement locations were selected to be reflective of the typical environmental ambient sound levels that a receptor may experience in the area.

Daytime measured data indicates an area with elevated noise levels, but, considering the spectral data and sounds heard, these sounds are mainly due to natural activities (wind-induced). Night-time measurements indicated a very quiet environment, even with low winds (around 0 – 2 m/s). Considering the measurements and measurements conducted in the last few years at similar areas, acceptable rating levels for the area would be typical of a rural noise district.

There is a high confidence in the ambient sound levels measured and the subsequent Rating Levels determined. For the purpose of this comparative impact study, the strictest rating level (rural) will be used as defined in SANS 10103:2008 (35 dBA at night, 45 dBA during the day) for all the receptors living in the area.

The data indicates an area where ambient sound levels are elevated, mainly due to natural sound sources relating to bird communication, as well as wind induced noises. Ambient sound levels are also illustrated on **Figure 6-1**. As illustrated on this figure, ambient sound levels does increase as wind speeds increase and sound levels ranging between 45 and 60 dBA are expected during periods when the WEF may be operational.

5 POTENTIAL NOISE SOURCES

5.1 CHANGES IN NOISE SOURCES: OPERATIONAL PHASE

The developer proposes to amend to the turbine specifications for the Perdekraal West WEF. The intended amendments include:

- Increase in the rotor diameter from 120 m to up to 155 m;
- Increase in the hub height to a maximum of 120m;
- Blade tip height of up to 198m;
- Increase wind turbine generation capacity from 1.5MW to 6MW; and
- Decrease the number of WTG from 60-65 to 47.

For the purpose of this noise assessment the sound power emission levels of the Goldwind GW140/3S WTG was used. The 2014 noise impact study made use of the sound power emission levels of the Acciona AW125/3000 WTG. The sound power emission level curves are illustrated for these wind turbines in **Figure 5-1**.

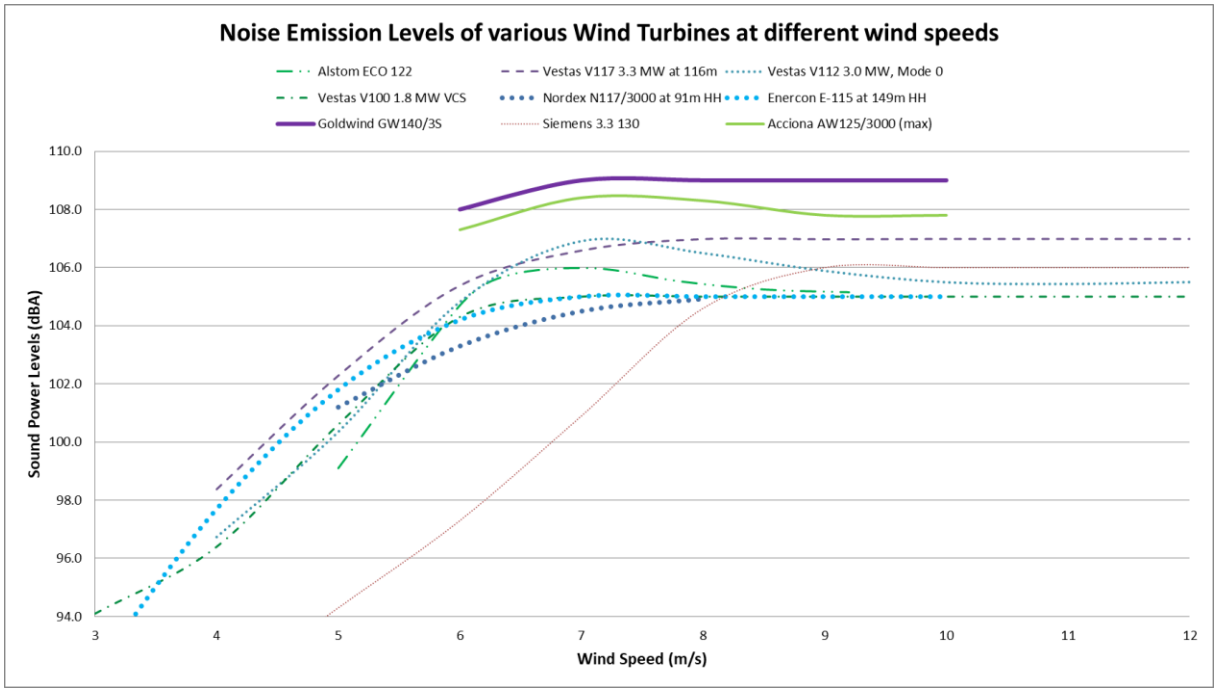

Figure 5-1: Noise Emissions Curve of a number of different wind turbines

The propagation model makes use of various frequencies, because these frequencies are affected in different ways as it propagates through air, over barriers and over different ground conditions. It allows a higher accuracy than models that only use the total sound power level. The octave sound power levels for various wind turbines are presented on **Figure 5-2**. As the third octave sound power levels were not available for the Goldwind WTG, this assessment will use the spectral data from the Acciona WTG.

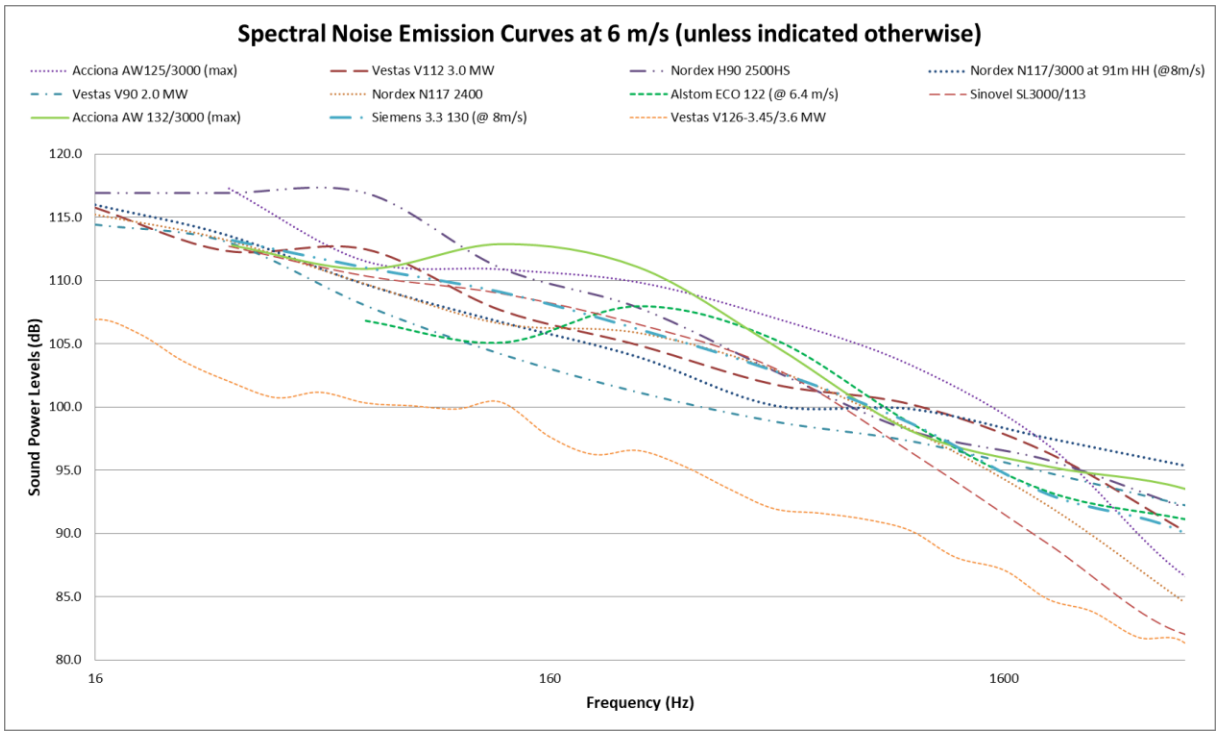

Figure 5-2: Octave sound power emissions of various wind turbines

6 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

6.1 DETERMINING APPROPRIATE ZONE SOUND LEVELS

SANS 10103:2008 does not cater for instances when background ambient sound levels change due to the impact of external forces. Locations close (closer than 500 meters from coastline) from the sea for instance always has an ambient sound 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 considered in the SANS standard.

Setting noise limits relative to the ambient sound level is relatively straightforward when the prevailing ambient sound level and source level are constant. However, wind turbines only start to operate when wind speeds exceed 3 m/s. Noise emissions therefore relates to the wind speed and similarly, the environment in which they are heard also depends upon the strength of the wind and the noise associated with its effects. It is therefore necessary to derive an ambient sound 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 ambient sound level in the same wind conditions.

6.1.1.1 Using International Guidelines to set Noise Limits

When assessing the overall noise levels emitted by a Wind Energy Facility, it is necessary to consider the full range of operating wind speeds of the wind turbines. This covers the wind speed range from around 3-5 m/s (the turbine cut-in wind speed) up to a wind speed range of 25-35 m/s measured at the hub height of a wind turbine. However, ETSU-R97 (1996) 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 12 m/s at 10 m height;
2. Reliable measurements of background ambient sound 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; and
4. If a wind farm meets noise limits at wind speeds lower than 12m/s, it is most unlikely to cause any greater loss of amenity at higher wind speeds. Turbine noise levels increase only slightly as wind speeds increase; however, background ambient sound levels increase significantly with increasing wind speeds due to the force of the wind.

Ambient sound vs. wind speed data is presented in **Figure 6-1**[1]. These are the results of numerous measurements at quiet (as per the opinion of the author) locations where there were no apparent or observable sounds that would have impacted on the measurements, presenting the A-Weighted, night-time ambient sound levels at an inland area. The figures clearly indicate a trend where sound levels increase if the wind speed increases. This has been found at all locations where measurements have been done for a sufficiently long enough period of time (more than 30 locations – more than 38,000 measurements).

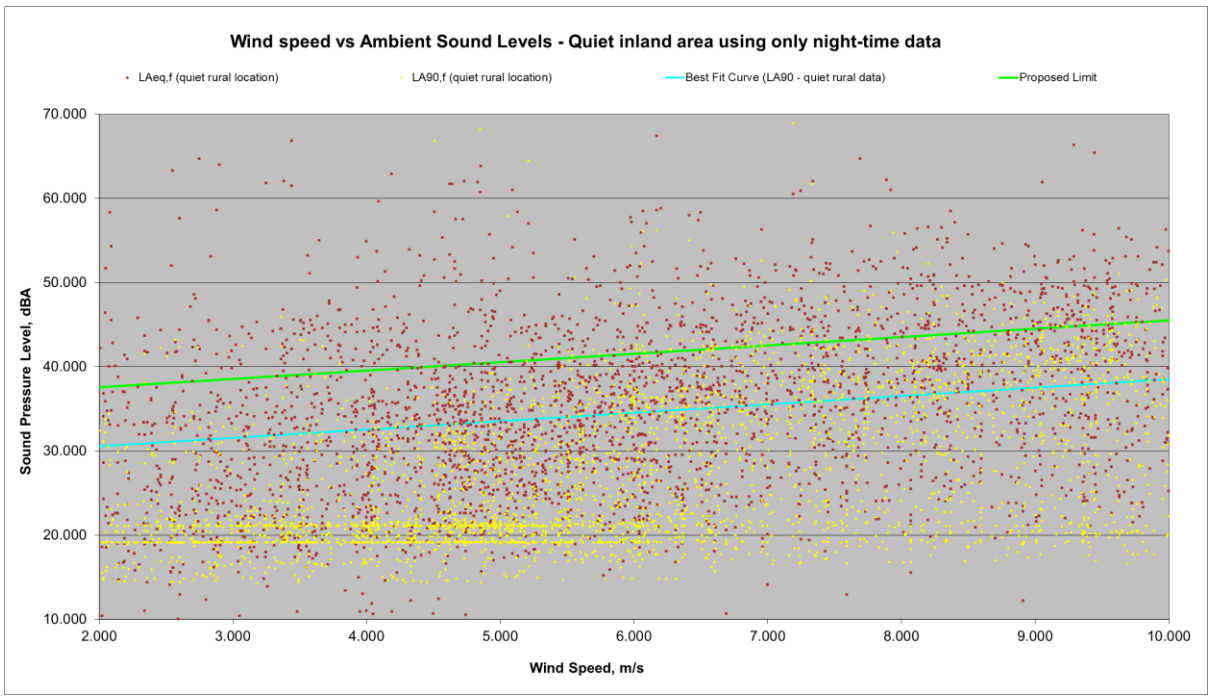

Figure 6-1: Ambient sound levels – quiet inland location (A-Weighted)

In addition, project participants could be exposed to noise levels up to 45 dBA (ETSU-R97) at lower wind speeds.

6.1.1.2 Using local regulations to set noise limits

Noise limits as set by the Provincial Noise Control Regulations (PN 200 of 2013 – **section 3.1.1** defines a "**disturbing noise**" as the noise that —

(a) exceeds the rating level by 7 dBA;

(b) exceeds the residual noise level where the residual noise level is higher than the rating level;

(c) exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or

[1] The sound level measuring instruments were located at a quiet location in the garden of the various houses. Data was measured in 10-minute bins and then co-ordinated with the 10 m wind speed derived from the wind mast of the developer. This wind mast normally was not close to the dwelling, at times being further than 5,000 meters from the measurement location. It is possible that the wind may be blowing at the location of the wind mast with no wind at the measurement location, resulting in low sound levels recorded.

(d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103;

Based developmental character, much of the area is a rural noise district, night-time rating levels would be 35 dBA and a noise level exceeding 42 dBA could be a disturbing noise (therefore the noise limit). The daytime rating level is 45 dBA (52 dBA for a disturbing noise).

Considering **Figure 6-1** , ambient sound levels may increase as wind speeds increase (**green** line), with the 7 dBA limit represented by the **cyan** line.

6.2 DETERMINING THE SIGNIFICANCE OF THE NOISE IMPACT

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts from the Integrated Environmental Management Information Series (DEAT, 2002). While this is a comparison assessment, this assessment will develop a full noise propagation model as well as evaluate the potential noise impact as if this was a typical noise impact assessment.

The level of detail as depicted in the Environmental Impact Assessment (EIA) 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 ENIA stage.

The impact consequence is determined by summing the scores of Magnitude (**Table 6.1**), Duration (**Table 6.2**) and Spatial Extent (**Table 6.3**). The impact significance is determined by multiplying the Consequence result with the Probability score (**Table 6.4**).

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

Table 6.1: 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 6.2: 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 6.3: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact		
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 6.4: 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

6.2.1 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.

6.2.2 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.

6.3 REPRESENTATION OF NOISE LEVELS

Noise rating levels will be calculated in the ENIA report using the appropriate sound propagation models as defined. It is therefore important to understand the difference between sound or noise level as well as the noise rating level (also see Glossary of Terms, **Appendix A**).

Sound or noise levels generally refer 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 were added. These noise rating levels are further processed into a 3D map illustrating noise contours of constant rating levels or noise isopleths. In the ENIA it will be used to illustrate the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time.

7 PROJECTED NOISE RATING LEVELS

7.1 PROPOSED CONSTRUCTION PHASE NOISE IMPACT

Construction activities are highly dependent on the final operational layout. The layout as provided by the developer is presented in **Figure 7-1**. As can be seen from this layout, a number of different activities might take place close to potentially sensitive receptors, each with a specific potential impact.

7.1.1 Description of Construction Activities Modelled

Construction activities are complex and are constantly changing during the construction phase. Modelling construction activities is similarly difficult and a number of processes are assumed, normally leaning towards a worst case scenario, assuming numerous activities taking place simultaneously, with the activities generating maximum noise levels for a certain percentage of time (represented in number of hours over a period of time). As an example, a bulldozer may only generate maximum noise levels when under full load (e.g. clearing a piece of land). For times when the bulldozer is reversing or just idling it, would not generate maximum noise levels.

As it is unknown where the different activities may take place, it was selected to model the impact of the activity associated with the most noise (laying of foundation totalling 113.6 dBA cumulative noise impact – various equipment operating simultaneously) at all locations (over the full daytime period of 16 hours) where wind turbines (or power pylons) may be erected, calculating how this may impact on potential noise-sensitive developments (see **Figure 7-2**).

Figure 7-2: Projected construction noise rating levels – Decay of noise from conceptual construction activities

Even though construction activities are projected to take place only during day time, it might be required at times that construction activities take place during the night (particularly for a large project). Construction activities that may occur during night time:

- Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day; and
- Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore, it is hard to judge beforehand if a construction team would be required to work late at night.

Figure 7-1: Wind Turbine Locations (and other infrastructure) for the Perdekraal West WEF

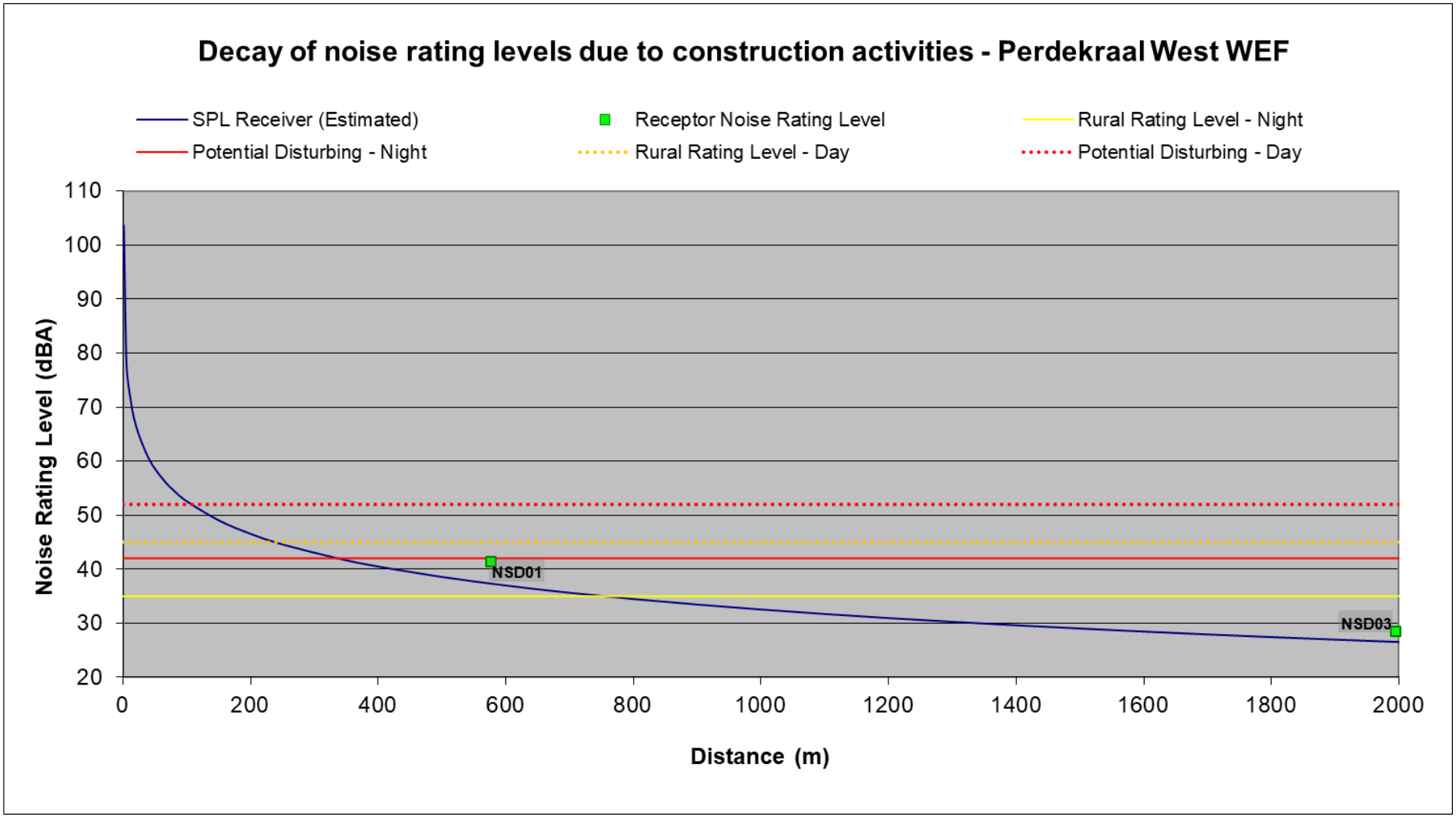

Figure 7-2: Projected construction noise rating levels[2] – Decay of noise from conceptual construction activities

[2] The SPL Receiver graph can also be used for the construction of the overhead power line to allow connection to the ESKOM grid. Any activities further than 400 m from any receiver should have a noise impact of low significance (both day and night-time activities).

7.2 OPERATIONAL PHASE NOISE IMPACT

The daytime period was not considered for this comparative assessment. Noise generated during the day by the WEF is generally masked by other noises from a variety of sources surrounding potentially noise-sensitive developments. However, times when a quiet environment is desired (at night for sleeping, weekends etc.), ambient sound levels are more critical. The time period investigated therefore would be a quieter period, normally associated within the 22:00 – 06:00 timeslot. Maintenance activities would therefore not be considered, concentrating on the ambient sound levels created due to the operation of the various Wind Turbine Generators (WTG's) at night.

The presented layout (see **Figure 7-1**) was modelled in detail using the sound power emission levels for the Goldwind GW140/3S WTG as defined in **Table 7-1**.

Table 7-1: Sound Emission characteristics used for modelling

Octave Sound Power Levels: Acciona AW125/3000									
Frequency	**31.5**	**63**	**125**	**250.0**	**500**	**1000**	**2000**	**4000**	**8000**
Lpa (dB)	117.3	111.5	110.9	109.9	107.0	103.3	97.0	86.6	81.3
A-Weighted Sound Power Levels: Goldwind GW140/3S									
Wind speed (m/s)	6		7		8		9		10
L_{WA}(dBA)	108		109		109		109		109

Total noise rating levels are illustrated in **Figure 7-3** with **Table 7-2** defining the noise rating levels at the closest potential noise-sensitive receptors (maximum noise emission levels – 109 dBA at a 7 m/s wind speed).

Table 7-2: Noise rating levels at closest potential noise-sensitive receptors at a 10m/s wind speed

NSD	Maximum Noise rating levels, Perdekraal West WEF (dBA)	Likely sound levels at a 7 m/s wind speed, based on Figure 6-1.
1	45.0	36 – 42 dBA
2	28.6	36 – 42 dBA
3	32.0	36 – 42 dBA

7.3 DECOMMISSIONING AND CLOSURE PHASE NOISE IMPACT

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the construction and operational phases. Noise from the decommissioning and closure phases will therefore not be investigated further.

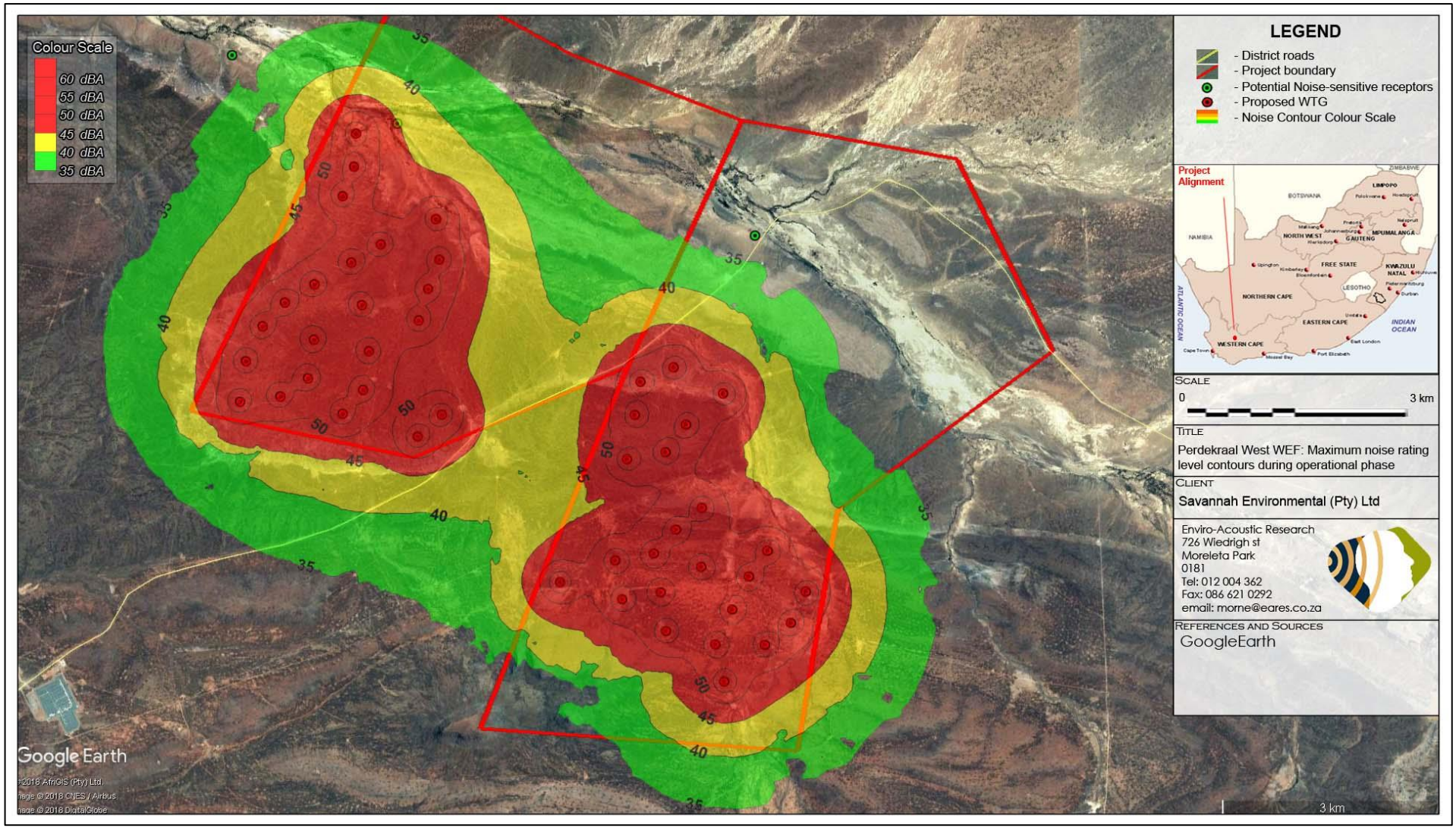

Figure 7-3: Projected maximum noise rating levels of the Perdekraal West WEF during operation

8 COMPARATIVE NOISE IMPACT ASSESSMENT

8.1 PLANNING PHASE NOISE IMPACT

No noise is associated with the planning phase and this will not be investigated further.

8.2 CONSTRUCTION PHASE NOISE IMPACT

Considering the projected noise levels and how construction activities may impact on the surrounding receptors during a period when a quiet environment is desirable, there is a low risk for a noise impact (see **Table 8-1**). The 2014 review report did not assess the construction phase. This was assessed in the 2016 report, determining a noise impact of negligible significance.

Table 8-1: Comparative Noise Impact Assessment: Night-time construction

Nature of Impacts: *Increases in noise levels at the closest receptors NSD02 and NSD03 in the area during a period when a quiet environment is desirable.*		
Sensitivity of the area: *The area has a rural developmental character and ambient sound levels are typical of a rural noise district. It may become very quiet at night and introduced noises may be clearly audible during these quiet times.*		
	Without Mitigation	***With Mitigation***
Magnitude (Table 6.1)	*Minor (2) for NSD02 and 03*	*Minor (2) for NSD02 and 03*
Duration (Table 6.2)	*Temporary (1)*	*Temporary (1)*
Extent (Table 6.3)	*Local (2)*	*Local (2)*
Probability (Table 6.4)	*Possible (2)*	*Possible (2)*
Significance	***Low (10)***	***Low (10)***
Status (positive/negative)	*Negative*	*Negative*
Reversibility	*Highly reversible*	*Highly reversible*
Loss of resources	*No loss of resource*	*No loss of resource*
Can impacts be mitigated	*Yes but not required*	*Yes but not required*
Gaps in Knowledge: *There is sufficient information available to have a high confidence in the findings of this assessment.*		
Comments: *High confidence in assessment.*		
Mitigation Measures: *The significance of the noise impact is low and no mitigation is required.*		
Cumulative impact: *Noise from the project would cumulatively add to ambient sound levels in the area, but the cumulative effect would be less than 3 dBA and of insignificant magnitude.*		

Residual Risks: *There are no residual risks as the noise impact will stop once the activity stops.*

The proposed amendments will not change the significance of the noise impact during construction from the previous report (de Jager, 2016) and no new mitigation will be required.

8.3 OPERATIONAL PHASE NOISE IMPACT

Only the night-time scenario was assessed, as this is the most critical time period when a quiet environment is desired. The noise rating levels are calculated in **Section 7.2** for the various operational activities defined in **Section 5.1**. As can be seen from **Table 7-2**, the projected noise rating levels will be 45 dBA at NSD01 (reported derelict dwelling) and significantly less at NSDs 02 and 03. The significance of the noise impact will not change and remain low as per the 2014 and 2016 studies and no new mitigation will be required. It is also summarized in **Table 8-2** for NSD02 and 03.

Table 8-2: Impact Assessment: Operational Activities at night

Nature of Impacts: *Increases in noise levels at the closest receptors NSD02 and NSD03 in the area during a period when a quiet environment is desirable.*		
Sensitivity of the area: *The area has a rural developmental character and ambient sound levels are typical of a rural noise district. It may become very quiet at night and introduced noises may be clearly audible during these quiet times.*		
	Without Mitigation	**With Mitigation**
Magnitude (Table 6.1)	*Minor (2) for NSD02 and 03*	*Minor (2) for NSD02 and 03*
Duration (Table 6.2)	*Low (4)*	*Low (4)*
Extent (Table 6.3)	*Local (2)*	*Local (2)*
Probability (Table 6.4)	*Possible (2)*	*Possible (2)*
Significance	***Low (16)***	***Low (16)***
Status (positive/negative)	*Negative*	*Negative*
Reversibility	*Highly reversible*	*Highly reversible*
Loss of resources	*No loss of resource*	*No loss of resource*
Can impacts be mitigated	*Yes but not required*	*Yes but not required*
Gaps in Knowledge: There is sufficient information available to have a high confidence in the findings of this assessment.		
Comments: High confidence in assessment.		
Mitigation Measures: The significance of the noise impact is low and no mitigation is required.		
Cumulative impact: Noise from the project would cumulatively add to ambient sound levels in the area, but the cumulative effect would be less than 3 dBA and of insignificant magnitude.		

Residual Risks:
There are no residual risks as the noise impact will stop once the activity stops.

8.4 ADVANTAGES AND DISADVANTAGES OF THE AMENDMENT

The proposed renewable power generation activities (worse-case evaluated) will very slightly raise the noise levels at a number of the closest potential noise-sensitive developments. There is no alternative location where the wind farm can be developed as the presence of a viable wind resource determines the viability of a commercial WEF. While the location cannot be moved, the wind turbines within the WEF can be moved around, with this layout being the result of numerous evaluations and modelling to identify the most economically feasible and environmentally friendly layout.

The project will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa and locally. The project will generate short and long-term employment and other business opportunities and promote renewable energy in South Africa and locally. People in the area that are not directly affected by increased noises generally have a more positive perception of the renewable projects and understand the need and desirability of the project.

The projected noise levels of this amendment will be similar to the noise levels previously modelled, and in terms of acoustics, there is no particular advantages or disadvantages with this amendment.

9 CONCLUSIONS AND RECOMMENDATIONS

This report is an Environmental Noise Impact Assessment of the predicted noise environment for the proposed turbine layout and specification amendments to the Perdekraal West Wind Energy Facility north of Touws River, making use of sound propagation models to identify potential issues of concern.

Considering the modelled construction and operational noise levels, the proposed changes to the wind turbines (and minor layout changes) will not lead to any other noise impacts, neither will it change the significance of the noise impact as defined in the original impact assessment report, nor will any further mitigation measures be required. The findings and recommendations highlighted in the 2014 report would remain the same.

The projected noise levels of this amendment will be similar to the noise levels previously modelled, and in terms of acoustics, there is no particular advantages or disadvantages with this amendment.

Considering the possible **low** significance of the noise impact the proposed amendment of the Perdekraal West WEF can be authorised.

10 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 2014, as amended, 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, 2014, as amended.

_____
Signature of the environmental practitioner:

Enviro-Acoustic Research cc
Name of company:

_____
Date:

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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.

End of report

EAR
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Date: 3 August 2018
Ref: Perdekraal West WEF

Savannah Environmental (Pty) Ltd
PO Box 148
SUNNINGHILL
2157

Attention: Mr Shaun Taylor

Dear Sir

SPECIALIST STUDY: ENVIRONMENTAL NOISE IMPACT ASSESSMENT: PROPOSED PERDEKRAAL WEST WIND ENERGY FACILITY: MINOR CHANGE OF LAYOUT

The above-mentioned issue as well as report SE-BTPWWEF/ENIA/201707-Rev 1 is of relevance. This comparative assessment reviewed the layout dated 20 June 2018.

Subsequent to this review, the Perdekraal West Wind Farm (Pty) Ltd updated the turbine layout to address potential impacts in terms of various sensitivities. The updated turbine layout is illustrated in **Figure 1**, with the same figure depicting the layout as reviewed in report SE-BTPWWEF/ENIA/201707-Rev 1.

Considering the minor changes, the findings of the review report and the location of the potential noise-sensitive developments, this updated layout will not change the noise levels as modeled at the potential noise-sensitive receptors. The update will not change the significance of the noise impact. A new review with new modeling will not be required and the recommendations as contained in report SE-BTPWWEF/ENIA/201707-Rev 1 will still be valid.

Should you require any further details, or have any additional questions, please do not hesitate to call me on the above numbers.

Yours Faithfully,

Morné de Jager
Enviro-Acoustic Research cc

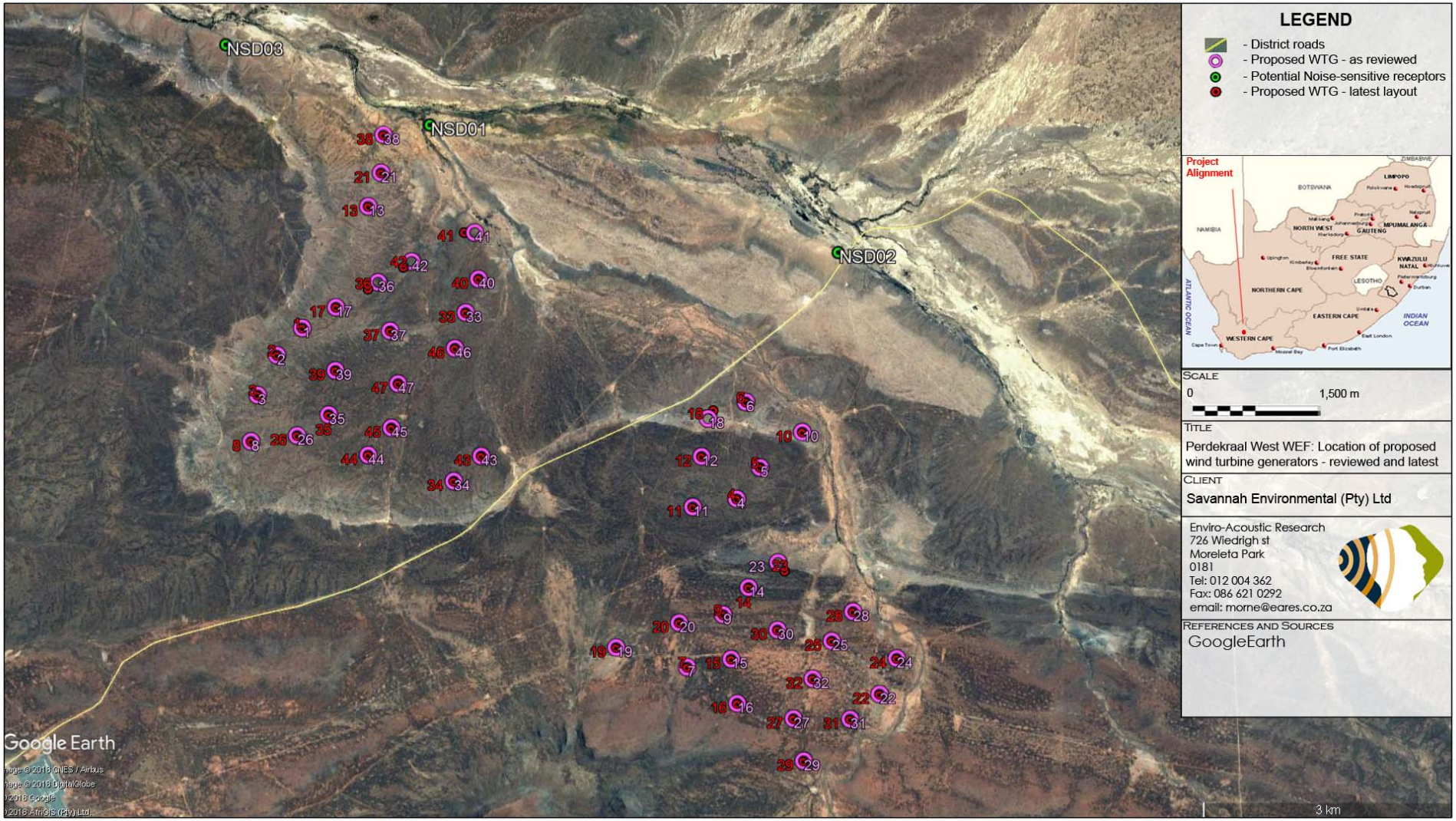

Figure 1: Noise emission levels of various wind turbines