Spiorad na Mara Offshore Wind Farm

Offshore Project

Environmental Impact Assessment Report

Appendix 19.4: Wind Shear Correction, Volume 2c

Document reference No.: SNM-SNM-PAC-APP-1194

Date: February 2026

Quality Control Page

Document details	
Document title	Offshore Project Environmental Impact Assessment Report
Document subtitle	Appendix 19.4: Wind Shear Correction
Document Reference No.	SNM-SNM-PAC-APP-1194
Date	February 2026
Version	1.0
Author	WSP
Client Name	Spiorad na Mara Limited

Document history

Version	Revision	Issued	Checked	Approved	Date	Comments
1.0	A	WSP	WSP	SnM Ltd	February 2026	Final for submission

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1 INTRODUCTION

1.1 OVERVIEW

1.1.1.1 This appendix of the Environmental Impact Assessment Report (EIAR) presents the wind shear correction method and calculations of offshore airborne noise of the proposed Spiorad na Mara Offshore Wind Farm (hereafter referred to as 'the Offshore Project'). This appendix accompanies **Chapter 19: Offshore Airborne Noise, Volume 2a** of the EIAR.

1.1.1.2 This appendix should be read in conjunction with the project description provided in **Chapter 3: Project Description, Volume 1a** and the relevant parts of the following chapters and appendices:

- **Chapter 19, Volume 2a**;
- **Appendix 19.1: Policy, Guidance and Legislative Context, Volume 2c**;
- **Appendix 19.2: Noise Modelling and Prediction, Volume 2c**;
- **Appendix 19.3: Baseline Noise Survey, Volume 2c**;
- **Appendix 19.5: Baseline Noise Conditions - All Wind Directions, Volume 2c**;
- **Appendix 19.6: Baseline Noise Analysis Comparison - Design Option 1 vs Design Option 2, Volume 2c**;
- **Appendix 19.7: Baseline Noise Conditions - Directional Split, Volume 2c**;
- **Appendix 19.8: Existing Wind Turbine Contribution Check, Volume 2c**;
- **Appendix 19.9: Modelled Receptor Noise Levels, Volume 2c**;
- **Appendix 19.10: Noise Limits, Volume 2c**;
- **Appendix 19.11: Cumulative Wind Turbine Noise Assessment, Volume 2c**.

1.1.2 PROJECT BACKGROUND

1.1.2.1 Spiorad na Mara Limited (hereafter referred to as 'the Applicant') is proposing to develop the Project. The Project is an offshore wind farm (OWF) that will consist of up to 60 fixed-bottom wind turbine generators (WTGs).

1.1.2.2 The Project will include both offshore and onshore infrastructure. This EIAR supports the application for the offshore components of the Project as outlined in **Chapter 1: Introduction, Volume 1a**. The offshore components of the Project (the Offshore Project) includes all infrastructure and activities located seaward of Mean High Water Springs (MHWS) within the Array Area and Offshore Cable Area of Search (OCAS) (**Figure 1.2: Offshore Project Location, Volume 1b**). Further detailed information is provided in **Chapter 3, Volume 1a**.

1.1.2.3 The Offshore Project is situated off the northwest coast of Isle of Lewis/*Eilean Leòdhais* and the Array Area is located approximately 5-13 km offshore and is approximately 161 km^2 in size. It will comprise WTGs, foundations, Offshore Cables, Offshore Substation Platform (OSP) (if required),

and Landfall. The Array Area combined with the OCAS is defined as the Offshore Project Boundary. The water depths across the Turbine Area range from 37 m-67 m with the southwest corner of the Array Area reaching 72 m. The proposed WTGs and fixed foundations will be located within a Turbine Area of approximately 140 km^2, within the Array Area.

1.2 PURPOSE OF THIS APPENDIX

1.2.1.1 This appendix describes the wind shear correction method for the offshore airborne noise assessment.

2 WIND SHEAR CORRECTION METHOD

2.1.1.1 As defined in the Institute of Acoustics: *A Good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (IOA GPG), *"wind shear is the variation in horizontal wind speed with height above ground level (AGL). Under most conditions, wind speeds increase with height above ground and various equations can be used to describe this."*

2.1.1.2 The IOA GPG advises that the standard procedure should be to reference noise measurement data to standardised 10 m height wind speed. The standardised 10 m wind speed is obtained from the wind turbine hub height wind speed, correcting it to 10 m height using a ground roughness factor of 0.05 m.

2.1.1.3 There are two different methods of determining hub height wind speed. The first one is to measure wind speed at hub height with the use of a hub height anemometer, or a Light Detection and Ranging (LiDAR) or Sound Detection and Ranging (SoDAR) system. The second method is to measure wind speed at two different heights below hub height, from which the wind shear can be determined and hub height wind speed subsequently deduced.

2.1.1.4 The completed assessment has applied the second method, as outlined below.

2.1.1.5 The wind shear exponent for each 10-minute measurement period was calculated using the following equation:

$$m = \left(\frac{Log\left(u_1/u_2\right)}{Log\left(h_1/h_2\right)}\right)$$

where:

m = wind shear exponent;

u_1 = wind speed measurement at the lower height;

u_2 = wind speed measurement at the higher height;

h_1 = height of the lower wind speed measurement;

h_2 = height of the upper wind speed measurement.

2.1.1.6 The equation was then rearranged as follows:

$$u_1 = u_2 \times \left(\frac{h_2}{h_1}\right)^m$$

2.1.1.7 This equation was used to calculate the hub height wind speed, except for periods where a negative shear was determined, in which case the hub height wind speed was assumed to equal the upper measured wind speed.

2.1.1.8 The hub height wind speed was then corrected to standardised 10 m height using the following equation (roughness length shear profile):

$$u_{10} = u_{hh} \times \left(\frac{Log(^{10}/_{z_0})}{Log(^{hh}/_{z_0})}\right)$$

where:

u_{10} = standardised 10 m height wind speed;

u_{hh} = hub height wind speed;

z_0 = standard ground roughness length of 0.05 m;

hh = hub height.

3 GLOSSARY OF TERMS AND ABBREVIATIONS

3.1.1.1 A list of key terms and acronyms used in this appendix are provided in **Table 3-1** and **Table 3-2**.

Table 3-1 Acronyms and abbreviations

Term	Definition
AGL	Above Ground Level
EIAR	Environmental Impact Assessment Report
IOA GPG	The Institute of Acoustics' guidance document: *A Good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise*
LiDAR	Light Detection and Ranging
MHWS	Mean High Water Springs
OCAS	Offshore Cable Area of Search
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
SoDAR	Sound Detection and Ranging
WTG	Wind Turbine Generator

Table 3-2 Glossary

Term	Meaning
h_1	Height of the lower wind speed measurement
h_2	Height of the higher wind speed measurement
m	Wind shear exponent
m	Metres
U_1 (or u_1)	Wind speed measurement at the lower height
U_2 (or u_2)	Wind speed measurement at the higher height
U_{10}	Wind speed at standardised 10 m height
U_{hh} (or u_{hh})	Wind speed at hub height
z_0	Standard ground roughness length of 0.05 m

4 REFERENCES

Institute of Acoustics (IOA). (2013). *A Good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise*. St Albans, UK: Institute of Acoustics. Available at: https://www.ioa.org.uk/sites/default/files/IOA%20Good%20Practice%20Guide%20on%20Wind%20Turbine%20Noise%20-%20May%202013.pdf. [Accessed 16 February 2026].

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