Aultmore Wind Farm Redesign

Technical Appendix 12:4 Remaining Noise Budget

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SLR Project No.: 405.03640.00016
Client Reference No: 03640

14 December 2023

Revision: 01

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Remaining Noise Budget Limits

12.4.1 Introduction

At the request of Morayshire Council (MC), in addition to showing that the predicted cumulative noise levels meet the derived cumulative noise limits according to the agreed background noise related derivation procedure, Remaining Noise Budget (RNB) limits have been derived. The methodology for this and resulting location specific limits are detailed in this technical appendix.

12.4.2 General Methodology

Where existing operational wind turbine developments are present within close proximity to a proposed scheme (such as the proposed development), and they have been consented either without substantive noise limits, or with limits not considering the need for future development, it is appropriate to derive noise limits for the proposed development using a RNB approach. This method accounts for headroom between the existing turbine noise contributions and the maximum permissible cumulative noise limits, derived in line with ETSU-R-97 The Assessment and Rating of Noise from Wind Farms and the requirements of MC, using the predicted noise levels for the existing schemes.

The RNB is calculated by using a logarithmic subtraction (as decibels are based on a logarithmic scale) of the predicted noise levels from existing developments (including an appropriate confidence interval, whilst ensuring that this is below the noise limits for each existing development)) from the cumulative noise limits. This confidence interval is added to allow for a turbine which is operating sub-optimally from an acoustic perspective, whilst still considered to be functioning effectively for power generation. A larger increase in noise level than this would be the result of significant operational issues and inefficiencies, which should be dealt with via a responsible maintenance regime and would significantly affect the generation, and therefore commercial viability of the turbine. In addition, where a scheme has been consented but not built, the confidence interval should allow for the selection of a different turbine model, which may be slightly 'louder' whilst within the same dimensional requirements of the planning conditions.

The logarithmic subtraction results in a calculated theoretical level (the RNB) which, when added to the existing cumulative wind turbine predicted noise level, would result in the overall cumulative noise level just meeting the cumulative noise limits. The RNB is derived in line with ETSU-R-97 and the Institute of Acoustics (IOA) publication A Good Practice Guide (GPG) to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise.

12.4.3 Site Specific Derivation

In this case, as each of the nearby existing developments are on the opposite side of the noise sensitive receptors to the proposed development, it is not possible in practice for the proposed development and existing schemes to have downwind propagation conditions concurrently. However, to ensure a conservative RNB calculation, the predicted contribution from all other wind turbine developments operating in the theoretical downwind condition has been subtracted from the derived cumulative noise limits. As this introduces an additional level of conservatism, it is considered that a further confidence interval is not required on top of the uncertainty factor already applied to the sound power level.

For the proposed development, it has been agreed with MC that where cumulative impacts need to be considered, cumulative noise limits would be the greater of 40dB $L_{A90\ 10\text{-}minutes}$ or quiet-daytime hours background noise level +5dB at each integer wind speed for day hours, and the greater of 40dB $L_{A90\ 10\text{-}minutes}$ or night hours background noise level +5dB at each integer wind speed for night hours. Where cumulative noise impacts do not need to be considered, the noise limits should be the greater of 38dB $L_{A90\ 10\text{-}minutes}$ or quiet-daytime hours background noise level +5dB at each integer

wind speed for day hours, and the greater of 40dB $L_{A90\ 10\text{-}minutes}$ or night hours background noise level +5dB at each integer wind speed for night hours.

For each location, the lower of the non-cumulative noise limit and the cumulative noise limit minus the predicted cumulative noise levels (excluding the proposed development) is used for each integer wind speed.

The derivation of the ETSU-R-97 noise limits is detailed in **Technical Appendix 12-1** & **12-2**, whilst the prediction methodology is detailed within **Technical Appendix 12-3**. The source noise levels, non-cumulative and cumulative noise limits are all detailed within **Chapter 12** of the **EIA Report**.

12.4.4 Cumulative Schemes Predicted Noise Level

Table 1 shows the predicted noise levels for the combination of the Balnamoon, Followsters, Lurg Hill, Myretone and Netherton schemes, not including any contribution from the proposed development.

Table 1: Cumulative Operational Noise Excluding Proposed Development Prediction Results (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Aultmore Lodge	22	27	30	31	31	32	32	32	32
Backies	26	30	34	35	35	36	36	36	36
Balnamoon Hill	24	28	31	32	32	33	33	33	33
Balnamoon Hill Cottage	23	28	31	32	33	34	34	34	34
Beechtree Farm	1	15	17	18	19	19	19	19	19
Beechtree Farm Caravan	1	15	17	18	19	19	19	19	19
Blackhills	2	9	11	13	13	14	14	14	14
Bossy Hillocks	28	33	36	38	39	40	40	40	40
Burn of Aultmore Croft	13	18	20	22	22	23	23	23	23
Burn of Aultmore Croft, 2	13	18	21	22	23	23	23	23	23
Burn of Aultmore Croft, 3	14	19	22	23	24	24	24	24	24
Clochmacreich	28	32	36	37	38	39	39	39	39
Coralside Croft	7	19	21	22	23	23	23	23	23
Craibstone Farm	24	29	32	33	34	34	34	34	34
Craibstone Farm Cottages	25	29	33	34	34	34	34	34	34
Croft of Fernking	11	17	20	21	22	22	22	22	22
Deerhill Croft	19	24	27	28	28	29	29	29	29
Deerhill Croft, Plot 2	20	25	28	29	29	29	29	29	29
Deerhill Farm	18	23	25	27	27	27	27	27	27
Drodland	13	18	21	22	22	23	23	23	23
East Balnamoon	27	31	34	35	36	37	37	37	37

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Fernking Croft	10	16	18	19	20	20	21	21	21
Goukstone Croft	24	29	32	33	34	35	35	35	35
Greenwells Croft	8	13	16	17	18	18	18	18	18
Hayfield	14	19	21	23	23	24	24	24	24
Heads of Auchinderran	2	25	26	27	28	29	29	29	29
Heads of Auchinderran Cottage	2	26	27	28	29	29	29	29	29
Hillfolds	7	12	15	16	17	17	17	17	17
Hillhead of Letterfourie	7	12	15	16	17	18	18	18	18
Hillhead of Starhill	25	30	33	34	34	34	34	34	34
Inkerman	8	13	16	17	18	18	18	18	18
Langlanburn	27	31	35	36	36	37	37	37	37
Marchbank	24	29	32	34	34	35	35	35	35
Muirton	9	14	17	18	19	19	19	19	19
Myreside	27	32	35	37	38	39	39	39	39
Near Hame	23	27	30	31	31	31	31	31	31
Netherton of Windyhills	33	36	40	42	43	45	45	45	45
Newtonbrae	7	22	23	24	25	26	26	26	26
Quarryhill Cottage	8	12	15	17	17	18	18	18	18
Raeffin	1	14	15	16	17	17	17	17	17
Redburn Farm	7	12	15	16	17	17	17	17	17
Redroofs Croft	25	30	33	34	35	35	35	35	35
Redroofs Croft, Plot 1	26	30	33	34	35	36	36	36	36
Redroofs Croft, Plot 2	26	30	33	35	35	36	36	36	36
Rowanbank	9	18	20	21	22	22	22	22	22
Rowanbrae Farm	0	15	16	17	18	19	19	19	19
Rowanbrae Farm Caravan	0	15	16	17	18	19	19	19	19
Ryeriggs Croft	1	17	18	19	20	21	21	21	21
Ryeriggs Plot 3	2	19	20	21	22	23	23	23	23
Schoolhill Croft	9	13	17	18	18	19	19	19	19
Schoolhouse Shielburn	8	13	16	17	18	19	19	19	19
Shielmuir	9	14	18	19	19	20	20	20	20
Stoneybank	7	11	14	16	16	17	17	17	17
Stripeside	15	19	23	24	24	25	25	25	25

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Sunnybrae Croft	8	20	21	22	23	24	24	24	24
Tarryfeuch	15	20	23	24	24	25	25	25	25
Tarrymount	1	10	12	13	14	15	15	15	15
The Bungalow Ryeriggs	1	18	19	20	21	22	22	22	22
The Herricks Caravan	8	18	20	21	21	22	22	22	22
Upper Allaloth	2	10	12	13	14	15	15	15	15
West Balnamoon	27	32	34	36	36	37	37	37	37
Wester Windyhills	28	33	36	38	39	40	40	40	40
Whitefield Farmhouse	7	12	15	16	17	17	17	17	17
Williamstown	9	13	17	18	18	19	19	19	19
Woodside Cottage	7	28	29	30	31	32	32	32	32

12.4.5 RNB Limits

Table 2 and Table 3 below show the RNB limits for all noise sensitive receptors within the proposed development 30dB L_{A90} noise contour for day and night hours according to the methodology outlined.

Table 2: Remaining Noise Budget Night-time Noise Limits (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Aultmore Lodge	40	40	40	39	39	39	39	39	39
Backies	40	40	39	38	38	38	38	38	38
Balnamoon Hill	40	40	39	39	39	43	48	48	48
Balnamoon Hill Cottage	40	40	39	39	39	42	48	48	48
Beechtree Farm	40	40	40	40	41	45	49	52	55
Beechtree Farm Caravan	40	40	40	40	41	45	49	52	55
Blackhills	40	40	40	40	41	45	49	52	55
Bossy Hillocks	40	39	38	36	33	40	47	47	47
Burn of Aultmore Croft	40	40	40	40	40	41	46	46	46
Burn of Aultmore Croft, 2	40	40	40	40	40	41	46	46	46
Burn of Aultmore Croft, 3	40	40	40	40	40	41	46	46	46
Clochmacreich	40	39	38	37	36	33	33	33	33
Coralside Croft	40	40	40	40	40	40	42	45	49
Craibstone Farm	40	40	39	39	39	39	39	39	39
Craibstone Farm Cottages	40	40	39	39	39	39	39	39	39

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Croft of Fernking	40	40	40	40	40	41	46	46	46
Deerhill Croft	40	40	40	40	40	43	48	48	48
Deerhill Croft, Plot 2	40	40	40	40	40	43	48	48	48
Deerhill Farm	40	40	40	40	40	41	46	46	46
Drodland	40	40	40	40	40	41	46	46	46
East Balnamoon	40	39	39	38	38	42	48	48	48
Fernking Croft	40	40	40	40	40	41	46	46	46
Goukstone Croft	40	40	39	39	39	42	48	48	48
Greenwells Croft	40	40	40	40	43	46	49	49	49
Hayfield	40	40	40	40	40	41	46	46	46
Heads of Auchinderran	40	40	40	40	41	45	49	52	55
Heads of Auchinderran Cottage	40	40	40	40	41	45	49	52	55
Hillfolds	40	40	40	40	43	46	49	49	49
Hillhead of Letterfourie	40	40	40	40	43	46	49	49	49
Hillhead of Starhill	40	40	39	39	39	42	48	48	48
Inkerman	40	40	40	40	43	46	49	49	49
Langlanburn	40	39	38	38	38	37	37	37	37
Marchbank	40	40	39	39	39	42	48	48	48
Muirton	40	40	40	40	43	46	49	49	49
Myreside	40	39	38	37	36	41	47	47	47
Near Hame	40	40	40	39	39	43	48	48	48
Netherton of Windyhills	40	40	40	40	40	35	45	45	45
Newtonbrae	40	40	40	40	40	40	42	45	49
Quarryhill Cottage	40	40	40	40	43	46	49	49	49
Raeffin	40	40	40	40	41	45	49	52	55
Redburn Farm	40	40	40	40	43	46	49	49	49
Redroofs Croft	40	40	39	39	38	42	48	48	48
Redroofs Croft, Plot 1	40	40	39	39	38	42	48	48	48
Redroofs Croft, Plot 2	40	40	39	38	38	42	48	48	48
Rowanbank	40	40	40	40	40	40	42	45	49
Rowanbrae Farm	40	40	40	40	41	45	49	52	55
Rowanbrae Farm Caravan	40	40	40	40	41	45	49	52	55
Ryeriggs Croft	40	40	40	40	41	45	49	52	55

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Ryeriggs Plot 3	40	40	40	40	41	45	49	52	55
Schoolhill Croft	40	40	40	40	41	45	49	49	49
Schoolhouse Shielburn	40	40	40	40	41	45	49	49	49
Shielmuir	40	40	40	40	41	45	49	49	49
Stoneybank	40	40	40	40	43	46	49	49	49
Stripeside	40	40	40	40	41	45	49	49	49
Sunnybrae Croft	40	40	40	40	40	40	42	45	49
Tarryfeuch	40	40	40	40	40	41	46	46	46
Tarrymount	40	40	40	40	41	45	49	52	55
The Bungalow Ryeriggs	40	40	40	40	41	45	49	52	55
The Herricks Caravan	40	40	40	40	40	40	42	45	49
Upper Allaloth	40	40	40	40	41	45	49	52	55
West Balnamoon	40	39	39	38	38	42	48	48	48
Wester Windyhills	40	39	38	36	33	40	47	47	47
Whitefield Farmhouse	40	40	40	40	43	46	49	49	49
Williamstown	40	40	40	40	43	46	49	49	49
Woodside Cottage	40	40	40	40	39	39	42	45	49

Table 3: Remaining Noise Budget Day-time Noise Limits (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Aultmore Lodge	38	38	41	44	49	49	49	49	49
Backies	38	38	40	43	49	49	49	49	49
Balnamoon Hill	38	38	38	38	40	44	47	50	50
Balnamoon Hill Cottage	38	38	38	38	40	44	47	50	50
Beechtree Farm	38	38	38	39	42	46	49	51	54
Beechtree Farm Caravan	38	38	38	39	42	46	49	51	54
Blackhills	38	38	38	39	42	46	49	51	54
Bossy Hillocks	38	38	38	36	37	42	46	50	50
Burn of Aultmore Croft	38	38	38	38	41	44	48	53	53
Burn of Aultmore Croft, 2	38	38	38	38	41	44	48	53	53
Burn of Aultmore Croft, 3	38	38	38	38	41	44	48	53	53
Clochmacreich	38	38	39	43	49	49	49	49	49
Coralside Croft	38	38	38	38	38	40	44	47	51

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Craibstone Farm	38	38	40	44	49	49	49	49	49
Craibstone Farm Cottages	38	38	40	44	49	49	49	49	49
Croft of Fernking	38	38	38	38	41	44	48	53	53
Deerhill Croft	38	38	38	38	41	44	47	50	50
Deerhill Croft, Plot 2	38	38	38	38	41	44	47	50	50
Deerhill Farm	38	38	38	38	41	44	48	53	53
Drodland	38	38	38	38	41	44	48	53	53
East Balnamoon	38	38	38	38	39	43	47	50	50
Fernking Croft	38	38	38	38	41	44	48	53	53
Goukstone Croft	38	38	38	38	40	43	47	50	50
Greenwells Croft	38	38	38	40	43	45	47	49	49
Hayfield	38	38	38	38	41	44	48	53	53
Heads of Auchinderran	38	38	38	39	42	46	49	51	54
Heads of Auchinderran Cottage	38	38	38	39	42	46	49	51	54
Hillfolds	38	38	38	40	43	45	47	49	49
Hillhead of Letterfourie	38	38	38	40	43	45	47	49	49
Hillhead of Starhill	38	38	38	38	40	44	47	50	50
Inkerman	38	38	38	40	43	45	47	49	49
Langlanburn	38	38	40	43	49	49	49	49	49
Marchbank	38	38	38	38	40	43	47	50	50
Muirton	38	38	38	40	43	45	47	49	49
Myreside	38	38	38	37	38	42	46	50	50
Near Hame	38	38	38	38	41	44	47	50	50
Netherton of Windyhills	38	38	38	38	41	35	43	48	48
Newtonbrae	38	38	38	38	38	40	44	47	51
Quarryhill Cottage	38	38	38	40	43	45	47	49	49
Raeffin	38	38	38	39	42	46	49	51	54
Redburn Farm	38	38	38	40	43	45	47	49	49
Redroofs Croft	38	38	38	38	40	43	47	50	50
Redroofs Croft, Plot 1	38	38	38	38	40	43	47	50	50
Redroofs Croft, Plot 2	38	38	38	38	40	43	47	50	50
Rowanbank	38	38	38	38	38	40	44	47	51
Rowanbrae Farm	38	38	38	39	42	46	49	51	54

Location	Standardised 10m height wind speed (m/s)								
	4	5	6	7	8	9	10	11	12
Rowanbrae Farm Caravan	38	38	38	39	42	46	49	51	54
Ryeriggs Croft	38	38	38	39	42	46	49	51	54
Ryeriggs Plot 3	38	38	38	39	42	46	49	51	54
Schoolhill Croft	38	38	38	41	44	48	52	56	56
Schoolhouse Shielburn	38	38	38	41	44	48	52	56	56
Shielmuir	38	38	38	41	44	48	52	56	56
Stoneybank	38	38	38	40	43	45	47	49	49
Stripeside	38	38	38	41	44	48	52	56	56
Sunnybrae Croft	38	38	38	38	38	40	44	47	51
Tarryfeuch	38	38	38	38	41	44	48	53	53
Tarrymount	38	38	38	39	42	46	49	51	54
The Bungalow Ryeriggs	38	38	38	39	42	46	49	51	54
The Herricks Caravan	38	38	38	38	38	40	44	47	51
Upper Allaloth	38	38	38	39	42	46	49	51	54
West Balnamoon	38	38	38	38	39	43	47	50	50
Wester Windyhills	38	38	38	36	37	42	46	50	50
Whitefield Farmhouse	38	38	38	40	43	45	47	49	49
Williamstown	38	38	38	40	43	45	47	49	49
Woodside Cottage	38	38	38	38	38	39	44	47	51

12.4.6 References

Department of Trade and Industry (1996), ETSU-R-97, The Assessment and Rating of Noise from Wind Farms. ETSU/DTI

Institute of Acoustics (May 2013). A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. IOA.